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FPSO EVACUATION SYSTEM PERFORMANCE IN A RANGE OF ENVIRONMENTAL CONDITIONS

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by

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National Research Council Canada
Institute for Marine Dynamics

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16. Abstract

This report describes the results of a physical model study aimed at establishing a baseline performance profile of lifeboat evacuation capability as a function of environmental conditions.

The main objectives of the study were to evaluate the evacuation capabilities of a totally enclosed motor propelled survival craft (TEMPSC) as a function of weather conditions and to evaluate the use of model testing as a tool for such safety studies.

The evacuation experiments were performed from a model Floating Production Storage and Offloading (FPSO) vessel at the Institute for Marine Dynamics Offshore Engineering Basin in February 2000. Twin falls davit deployment from the FPSO was tested in six different environmental conditions. Additional experiments were conducted for the modified evacuation system fitted with a flexible boom.

The most obvious trend was that control deteriorates radically with weather, regardless of the evacuation system used; however, motions of the FPSO had a major effect on the launch and made it difficult to determine the specific effects of weather conditions on launch performance. Model tests proved to be a suitable tool for the investigation. Indeed, where extreme weather events are of interest, physical model testing offered a reliable and safe means of performance evaluation.

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16. Résumé

Ce rapport décrit les résultats d'une étude avec maquette qui avait pour but d'établir les performances de base d'un dispositif de mise à l'eau d'embarcations de sauvetage dans diverses conditions environnementales.

Les objectifs assignés à l'étude étaient d'évaluer des dispositifs de mise à l'eau d'embarcations de sauvetage motorisées entièrement fermées (ESMEF) en fonction de diverses conditions météorologiques et d'évaluer la pertinence d'essais sur maquette pour une telle étude.

Les essais ont eu lieu à l'aide d'une maquette de navire de production et de stockage de pétrole (FPSO) dans le bassin d'étude des ouvrages de haute mer de l'Institut de dynamique marine, en février 2000. Le bossoir à garants doubles du FPSO a été déployé dans six états de mer différents. D'autres essais ont été réalisés sur un dispositif de mise à l'eau modifié, c.-à-d. muni d'un tangon écarteur flexible.

Ce qui est ressorti le plus clairement des expériences, c'est que les conditions météorologiques peuvent dégrader radicalement la commande de l'amenage, quel que soit le dispositif utilisé; cela dit, les mouvements du FPSO influaient grandement sur la mise à l'eau, d'où la difficulté de mesurer avec précision l'effet des conditions météorologiques sur la manoeuvre. Il s'est par ailleurs avéré que les essais avec maquette constituent un outil approprié pour ce type d'étude. De fait, pour l'étude d'événements météorologiques extrêmes, les essais avec maquette constituent une façon fiable et sûre d'évaluer les performances d'un dispositif de mise à l'eau.

17. Mots clés

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A consortium consisting of Transport Canada, the Canadian Association of Petroleum Producers, Natural Resources Canada, and National Research Council Canada provided subsequent funding for a broader evacuation performance research program, of which the work reported here is the first part.

The authors thank the people at IMD/NRC who contributed to the fabrication and instrumentation of the models, and helped carry out the experiments.

SUMMARY

This physical model study was aimed at establishing a baseline performance profile of lifeboat evacuation capability as a function of environmental conditions.

The lifeboat evacuation experiments were performed from a model Floating Production Storage and Offloading (FPSO) vessel at the Institute for Marine Dynamics Offshore Engineering Basin during the month of February 2000.

A twin falls davit evacuation system was used to deploy a totally enclosed motor propelled survival craft (TEMPSC) from the FPSO into wave and wind conditions ranging from calm (Beaufort Scale 0) to fresh gale (Beaufort Scale 8). The system was of the straight fall double wire category with the TEMPSC stowed and launched parallel to the hull. A total of 120 deployments were originally projected for the twin falls davit system. The test program was expanded to include a flexible boom-assisted launch arrangement. This brought the total number of deployments to over 180.

The FPSO was tested in its ballast, intact condition and was arranged such that it had a 20° heading to the waves and a 57° heading to the wind. The TEMPSC was deployed to the windward side. The model TEMPSC (100% load condition) was launched at random positions with respect to incident waves, and propulsion power was available when the boat hit the water.

Transport Canada, Canada-Newfoundland Offshore Petroleum Board, Offshore Safety and Survival Centre and other provincial government representatives witnessed a small but representative portion of the experiments.

Motions of the FPSO had a major effect on the launch and made it difficult to determine the specific effects of weather conditions on launch performance. Since it is evacuation system performance and the effects of configuration parameters, such as height of launch, clearance of TEMPSC at launch, orientation of TEMPSC at launch, direction of weather relative to launch, launch point on waves, and others that can be usefully evaluated by systematic model test series, a second phase of testing consisting of launches from a fixed platform is being considered.

SOMMAIRE

L'étude avec maquette avait pour but d'établir les performances de base d'un dispositif de mise à l'eau d'embarcations de sauvetage en fonction des conditions environnementales.

Les expériences de mise à l'eau d'embarcations mettaient en jeu une maquette de navire de production et de stockage de pétrole (FPSO). Elles ont eu lieu dans le bassin d'étude des ouvrages de haute mer de l'Institut de dynamique marine, en février 2000.

Un bossoir à garants doubles a été utilisé pour mettre à l'eau, à partir du FPSO, une embarcation de sauvetage motorisée entièrement fermée (ESMEF) dans des conditions de vent et de houle variant du degré 0 (calme) au degré 8 (coup de vent) sur l'échelle de Beaufort. Le bossoir était du type à garants doubles droits en fil d'acier avec une ESMEF à poste, mise à l'eau parallèlement à la coque. Il avait été prévu d'effectuer un total de 120 mises à l'eau à l'aide du bossoir à garants doubles. Mais il a été décidé d'étendre le programme d'essais à un dispositif muni d'un tangon écarteur flexible, ce qui a porté le nombre de mises à l'eau à plus de 180.

Le FPSO était sur ballast et sans aucune avarie. Il était maintenu à un cap de 20° par rapport aux vagues et de 57° par rapport au vent. L'ESMEF était mise à l'eau avec un plein chargement, du côté exposé au vent et dans des positions aléatoires par rapport aux vagues incidentes; ses moyens de propulsion étaient opérationnels dès le moment où elle touchait l'eau.

Des représentants de Transports Canada, de l'Office Canada-Terre-Neuve des hydrocarbures extracôtiers, de l'Offshore Safety and Survival Centre et de gouvernements provinciaux ont assisté à un échantillon limité mais représentatif des essais.

Compte tenu de l'importante influence des mouvements du FPSO sur la mise à l'eau, il a été difficile de déterminer avec précision les effets des conditions météorologiques sur les performances du dispositif. Comme des essais systématiques sur maquette s'avèrent tout indiqués pour évaluer les performances de dispositifs de mise à l'eau et les effets de divers paramètres de configuration (hauteur de mise à l'eau, dégagement et orientation de l'ESMEF pendant la mise à l'eau, direction du vent et de la houle, point d'impact de l'embarcation sur les vagues, entre autres) une deuxième phase d'essais est envisagée, qui consisterait en des mises à l'eau à partir d'une plate-forme fixe.

TABLE OF CONTENTS

		Page
1.0	**INTRODUCTION**	**1**
2.0	**PROJECT OBJECTIVES**	**2**
3.0	**PROJECT EVALUATION CRITERIA**	**2**
4.0	**PHYSICAL MODELS**	**3**
	4.1 Floating Production Storage and Offloading (FPSO) Vessel	3
	4.2 Totally Enclosed Motor Propelled Survival Craft (TEMPSC)	7
	4.3 Deployment System	9
	4.3.1 Twin Falls Davit	9
	4.3.2 Flexible Boom	10
5.0	**ENVIRONMENTAL MODELS**	**14**
	5.1 Regular Waves	14
	5.2 Wind	16
6.0	**INSTRUMENTATION**	**16**
	6.1 Data Acquisition	17
	6.2 Coordinate System	18
	6.3 Measurement Error	18
7.0	**QUALIFICATION TESTS**	**18**
	7.1 Calibrations	19
	7.2 Decay Tests	19
	7.3 Verification Tests	19
8.0	**TEST PROGRAM**	**20**
	8.1 Test Methodology	20
	8.2 Test Matrix	22
9.0	**RESULTS**	**23**
	9.1 Data Analysis and Techniques	23
	9.1.1 Statistical Analysis	24
	9.1.2 Zero-Crossing Analysis	24
	9.1.3 Response Amplitude Operators	24

9.1.4 Deployment Analysis 24
9.1.5 Event Analysis 25

10.0 DISCUSSION AND RESULTS 25
10.1 Systems Calibration (200 Series) 26
10.2 FPSO Motion Verification (300 Series) 27
10.3 TEMPSC Deployment from FPSO – Twin Falls Davit System (Series 400, 500,525,550,600,625) 32
10.3.1 400 Series – Calm Water 32
10.3.2 500 Series – Moderate Breeze 38
10.3.3 525 Series – Fresh Breeze 41
10.3.4 550 Series – Strong Breeze 44
10.3.5 600 Series – Moderate Gale 47
10.3.6 625 Series – Fresh Gale 50
10.4 TEMPSC Deployment from FPSO – Flexible Boom system (Series 700, 725, 800) 53
10.4.1 700 Series – Calm Water 53
10.4.2 725 Series – Fresh Breeze 57
10.4.3 800 Series – Fresh Gale 61

11.0 CONCLUSIONS 64

REFERENCES 73

Appendix 1 General Layout of the Offshore Engineering Basin
Appendix 2 FPSO Drawings, Hydrostatics and Mass Properties
Appendix 3 TEMPSC Drawings, Hydrostatics and Mass Properties
Appendix 4 Horizontal Mooring Configuration
Appendix 5 Flexible Boom System and Associated Equipment
Appendix 6 Environmental Calibrations
Appendix 7 Calibrated Sensors
Appendix 8 Qualification, Decay and Verification Tests
Appendix 9 Analyzed Test Results for Individual Experiments
Appendix 10 Video Log
Appendix 11 Selected Photographs of Construction, Setup and Testing Phases

LIST OF FIGURES

Figure 4.1 FPSO Model 4
Figure 4.2 FPSO Model Mooring System 4
Figure 4.3 FPSO Mooring Data Comparison 5
Figure 4.4 TEMPSC Canopy and Hull 8
Figure 4.5 Side View of TEMPSC Model 8
Figure 4.6 Twin Falls Davit System Setup 10
Figure 4.7 Flexible Boom Deployment System Setup 11
Figure 4.8 Flexible Boom Tip Deflection 13
Figure 4.9 Servo Motor Extension for Applied Load 13
Figure 10.1 Surge, Sway and Heave RAO Comparison 30
Figure 10.2 Yaw, Pitch and Roll RAO Comparison 31
Figure 10.3 Plan View of the Deployment 33
Figure 10.4 View along the Centreline of the TEMPSC 34
Figure 10.5 Outboard Profile of the Deployment 34
Figure 10.6 Calm Water, Plan View of Deployment Envelope 35
Figure 10.7 Calm Water, Outboard Profile of Deployment Envelope 36
Figure 10.8 Moderate Breeze, Plan View of Deployment Envelope 38
Figure 10.9 Moderate Breeze, Outboard Profile of Deployment Envelope 39
Figure 10.10 Fresh Breeze, Plan View of Deployment Envelope 41
Figure 10.11 Fresh Breeze, Outboard Profile of Deployment Envelope 42
Figure 10.12 Strong Breeze, Plan View of Deployment Envelope 44
Figure 10.13 Strong Breeze, Outboard Profile of Deployment Envelope 45
Figure 10.14 Moderate Gale, Plan View of Deployment Envelope 47
Figure 10.15 Moderate Gale, Outboard Profile of Deployment Envelope 48
Figure 10.16 Fresh Gale, Plan View of Deployment Envelope 50
Figure 10.17 Fresh Gale, Outboard Profile of Deployment Envelope 51
Figure 10.18 Calm Water, Plan View of Deployment Envelope Flexible Boom System 54
Figure 10.19 Calm Water, Outboard Profile of Deployment Envelope Flexible Boom System 55

Figure 10.20 Fresh Breeze, Plan View of Deployment Envelope Flexible Boom System 58

Figure 10.21 Fresh Breeze, Outboard Profile of Deployment Envelope Flexible Boom System 59

Figure 10.22 Fresh Gale, Plan View of Deployment Envelope Flexible Boom System 61

Figure 10.23 Fresh Gale, Outboard Profile of Deployment Envelope Flexible Boom System 62

Figure 11.1 Missed Target in Different Environments 65

Figure 11.2 Mean Time from Start of Launch to Splashdown 66

Figure 11.3 Time from Splashdown to Davit Release 67

Figure 11.4 Time from Splashdown to Safety Zone 68

Figure 11.5 TEMPSC Path Length from Splashdown to Safety Boundary Zone 68

Figure 11.6 TEMPSC Path Length from Danger to Safety Zone 69

Figure 11.7 Missed Target + Setback 70

Figure 11.8 Lateral Accelerations During Sail-Away 71

Figure 11.9 Oscillation Angles During TEMPSC Lowering 71

Figure 11.10 Path Envelopes in Sail-Away Phase (plan view at top) and Lowering and Sail-Away Phase (outboard profile) 72

LIST OF TABLES

Table 4.1 FPSO Hydrostatics and Mass Properties 6
Table 4.2 Summary of Natural Periods for Free-Floating and Moored FPSO 7
Table 4.3 TEMPSC Hydrostatic and Mass Properties 9
Table 4.4 Flexible Boom Tip Deflection and Servo Motor Extension with Load 12
Table 5.1 Environmental Conditions 14
Table 5.2 Summary of All Wave Files 16
Table 6.1 Approximate Measuring Errors 18
Table 8.1 Test Program 20
Table 8.2 Verification Tests Matrix 22
Table 8.3 Offshore Evacuation System Test Matrix 23
Table 10.1 Comparison of Natural Periods for Free-Floating and Moored FPSO 26
Table 10.2 Comparison of Natural Periods for FPSO and Similar Vessels 26
Table 10.3 Comparison of Metacentric Heights (GM_T) 27
Table 10.4 Comparison of Non-dimensional Longitudinal and Vertical Centres of Gravity 27
Table 10.5 Response Amplitude Operators Comparison 29
Table 10.6 Summary of Calm Water Deployment Data for Twin Falls Davit System 37
Table 10.7 Summary of Moderate Breeze Deployment Data for Twin Falls Davit System 40
Table 10.8 Summary of Fresh Breeze Deployment Data for Twin Falls Davit System 43
Table 10.9 Summary of Strong Breeze Deployment Data for Twin Falls Davit System 46
Table 10.10 Summary of Moderate Gale Deployment Data for Twin Falls Davit System 49
Table 10.11 Summary of Fresh Gale Deployment Data for Twin Falls Davit System 52
Table 10.12 Summary of Calm Water Deployment Data for Flexible Boom System 56
Table 10.13 Summary of Fresh Breeze Deployment Data for Flexible Boom System 60
Table 10.14 Summary of Fresh Gale Deployment Data for Flexible Boom System 63

GLOSSARY

A/D	Analog-to-Digital
BL	Ballast Load
FL	Full Load
FPSO	Floating Production Storage and Offloading
FSO	Floating Storage Offloading
GM_T	Transverse Metacentric Height
GRP	Glass Reinforced Plastic
IMD	Institute for Marine Dynamics
IMO	International Marine Organization
NEFF	Neff Instruments Corporation
NTSC	North American Television Standard Color
OEB	Offshore Engineering Basin
OEH	Offshore Engineering Handbook
QOTS	Qualisys Optical Tracing System
RAO	Response Amplitude Operators
SVHS	Super Video Home System
TEMPSC	Totally Enclosed Motor Propelled Survival Craft
VCG	Vertical Centre of Gravity
VHS	Video Home System
ZCA	Zero-Crossing Analysis

1.0 INTRODUCTION

This report covers a series of model scale experiments performed on a generic Floating Production and Offloading (FPSO) vessel fitted with a conventional twin falls davit evacuation system. The experiments were aimed at evaluating the performance capability of the evacuation system as a function of environmental conditions.

As the offshore oil and gas industry and its regulators move increasingly towards performance, or goal-based standards, rather than prescriptive rules, clearly defined performance measures and the means to quantify them become a necessity for assessing and managing safety.

Risk assessment is a design imperative and a regulatory requirement in many jurisdictions, but published quantitative data on lifeboat evacuation are sparse (Spouge 1999), which hampers the design process and attaches uncertainty to any regulatory goals. The results presented in this report help to narrow the knowledge gap.

Evacuation of an offshore petroleum installation, or ship, can occur under a range of situations, from a routine training exercise, to a precautionary partial evacuation, to an emergency. The degree of stress and related human factors, and the degree of physical impairment of the installation and personnel will be related to the type of situation. An evacuation of healthy personnel carried out with well-maintained equipment during a training exercise in good weather is likely to be more successful than an emergency evacuation of distressed and possibly injured personnel in foul weather with equipment that might be damaged by the event that caused the emergency.

These experiments focused on evacuation by lifeboats during emergencies, which must necessarily be done in prevailing weather conditions. Current regulations do not require operators, or duty holders, to demonstrate the capability of evacuation system performance as a function of weather conditions. Apart from their relevance to an overall safety assessment then, the results quantify performance at "the interface between a realised event and its consequences" (MacFarlane, 1994) that is, when it is actually needed. Systematic physical model experiments allow us to investigate evacuation performance and generate statistically reliable data that would otherwise be prohibitively dangerous to collect, if done with full-scale manned equipment under controlled conditions, or relatively uncertain, due to the low frequency of occurrence of actual installation evacuations, which are not controlled in the experimental sense (Royal Society Study Group 1992, pp.19-20).

The experiments were conducted at the Institute for Marine Dynamics (IMD), Offshore Engineering Basin (OEB) during the month of February 2000. The experimental work reported here deals only with the evacuation phase of the Escape-Evacuation-Rescue process.

Launch failures due to equipment failure, such as accidental release or inability to release, were not modeled. However, every reasonable avenue was explored to model the mechanical components of evacuation systems so that they perform in a physically accurate way.

Model launch failures attributed to launch equipment failure are not included in the results as this class of failure is not necessarily statistically representative of full scale.

2.0 PROJECT OBJECTIVES

The main objectives of the test program were quantification of evacuation system performance degradation as a function of environmental conditions and determination of the effect of evacuation system design variation on system performance. The objectives were met by a combination of individual experiments, evacuation scenario and component modeling:

- Development of a physical model test program that uses waves and wind direction for a particular FPSO condition as program variables.
- Verification tests aimed at determining that the FPSO vessel motions were representative of similar vessels in similar environmental conditions.
- Environmental conditions representative of East Coast of Canada.
- Condition of FPSO and Totally Enclosed Motor Propelled Survival Craft (TEMPSC) representative of a possible evacuation scenario.
- Modeling of the complete twin falls davit system, associated TEMPSC and pay-out speed as well as the flexible boom system with regards to boom deflection characteristics.
- All these features are incorporated into the physical model experiments of the lowering, splashdown and sail-away of the TEMPSC.

The benefits of conducting these experiments were:

- Quantification of evacuation system performance degradation as a function of environmental conditions.
- Determination of the effect of evacuation system design variation on system performance.
- Development of information that may be used by offshore platform managers in emergency evacuation situations.
- Establishment of a non-proprietary database on evacuation system baseline performance that may be used by designers, operators and regulators to make rational decisions.

3.0 PROJECT EVALUATION CRITERIA

In order to evaluate the evacuation process, several parameters, such as time from launch start to splashdown, time from splashdown to open sea, path length from splashdown to danger zone boundary, path length from danger zone boundary to safety zone boundary, distance from target to drop point, setback after splashdown, accelerations during lowering and sail-away, and oscillations during lowering and collisions were directly measured and/or derived. Evaluation criteria are as follows for both the experiments and the actual measurements:

Experiments

Twin falls davit deployments from the FPSO at 20° heading to the waves and 57° to the wind floating in an intact condition at the ballast draft and for six different environment conditions. Additional experiments for the modified evacuation system fitted with a flexible boom. All the experiments were performed from the windward side.

Measurements

Deployment Phase (from start of lowering to splashdown)

X-Y-Z position of the TEMPSC, lateral acceleration of the TEMPSC, davit payout speed, flexible boom position and load, collisions

Sail-Away Phase (from splashdown to outside the safe boundary zone)

X-Y-Z position of the TEMPSC, relative position of the TEMPSC with the FPSO, time to cross danger and safe boundary zones, average sail-away speed, lateral accelerations of the TEMPSC

4.0 PHYSICAL MODELS

Adequate physical models (i.e. models that accurately predict one or more characteristics of the prototype but not all the characteristics) of the FPSO vessel, TEMPSC and the flexible boom system and its components were designed and manufactured according to Froude scaling laws at a scale of 27.65. In the following sections a description of the vessel and the system is presented. Selected photographs of the different physical models and their components are incorporated in Appendix 11.

4.1 Floating Production Storage and Offloading (FPSO) Vessel

The FPSO hull included flat plate bilge keels, forecastle, bulwarks, an accommodation module and an enclosed main deck for water integrity. Remaining topside structures such as the process equipment module, helideck, flare tower, cranes and other above structures were left off. Provision for port and starboard TEMPSC launching systems were made but only the starboard side was used during the testing. It was determined that this would represent the worst-case scenario, since this was the windward side. Also from test program efficiency, observation and video recording considerations, deployment from one side was more advantageous.

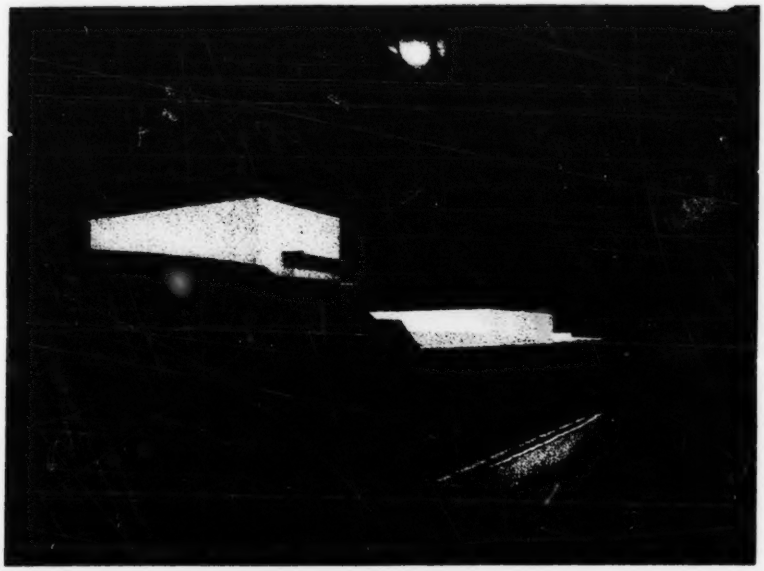

Figure 4.1 – FPSO Model

The model was further modified to carry an underwater rotatable mooring that was fitted at the centre of the moonpool and extended 310 mm below the cover of the moonpool. The moonpool cover was fitted at the same level as the bottom of the FPSO.

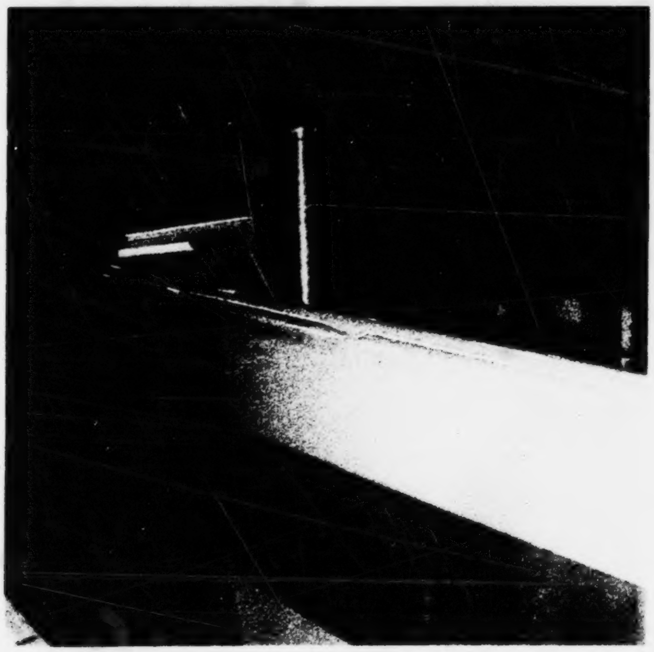

Figure 4.2 – FPSO Model Mooring System

The model mooring was located below the FPSO bottom and was designed to have the modeled stiffness characteristics of full-scale mooring lines. Detailed drawings of the model mooring are located in Appendix 4. The mooring system consisted of a mooring post attached to the model. At the bottom end of the post a 200 mm turntable was mounted to which three mooring lines were attached in a 120° radial spacing and extending underwater to spring support posts on the side of the basin. The springs were tri-rated and provided an equivalent mooring line restoring force. Figure 4.3 compares the tri-rate springs linearized mooring characteristics to those of a typical FPSO non-linear single group mooring characteristics. The linearized spring system is a good representation of the actual mooring system but differences occur in large excursions. These are non-linear systems that in these tests were modeled linearly.

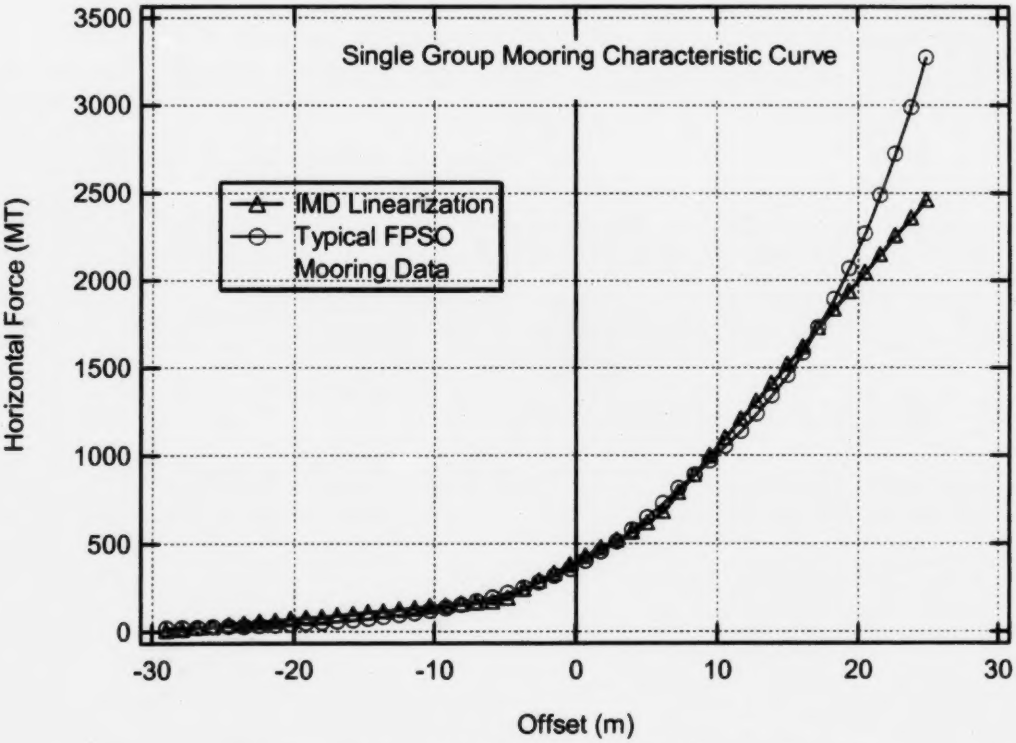

Figure 4.3 – FPSO Mooring Data Comparison

The model hull was constructed of Styrofoam®, wood and glass reinforced plastic (GRP). The model's internal structure consisted of a plywood box supported by transverse and longitudinal frames. Foam strips roughly 100 mm wide and 51 mm thick were glued to the box and reinforced with RenShape® (a high density foam) at the aft and forward thruster locations and in the moonpool area. The Institute's computer-controlled milling machine milled the model FPSO hull shape with a ball-nose cutter. The tool paths compensated for the thickness of the fibreglass, gelcoat and paint. The model was hand-finished, covered with two layers of 340 g/m^2 fibreglass cloth and epoxy resin and a layer of gelcoat that was faired smooth. The model hull surface was painted yellow; the accommodation module and deck covers were painted white.

Draft marks for the full and ballast loads were marked on both sides at stations 1, 2, 10, 19, 20 and at the longitudinal centre of the moonpool. A grid with its origin at the intersection of the midpoint between the davit arms and the keel of the TEMPSC in its launching position was marked on the side of the FPSO hull. The grid's *x*-increments were half the TEMPSC's overall length (5.1 m) and the *z*-increments were the TEMPSC's overall height (3.5 m).

The FPSO model was tested for the intact ballast load. The hydrostatics for the ballast load condition were calculated and the results are presented for both the model and full-scale vessels in Appendix 2. The empty FPSO model was weighed and swung using a large steel frame in order to measure the model's radii of gyration. The inertia of the ballast weights, the accommodation module, and deck covers were included by calculation. An inclining experiment was performed to determine the transverse metacentric height (GM_T) of the free-floating model. Weights located on either side of midships at deck level were used as trimming weights. The weights were moved port and starboard equal distances for the inclining experiment.

A summary of the hydrostatics and the mass properties is presented in Table 4.1 below.

Table 4.1 – FPSO Hydrostatics and Mass Properties

Floating Production Storage Offloading (FPSO) Vessel			
Condition	BL		Ballast
Length Between Perpendiculars	L_{PP}	m	277.0
Length on Water Line	L_{WP}	m	273.5
Beam	B	m	44.7
Draft at After Perpendicular	T_{AP}	m	12.81
Draft at Forward Perpendicular	T_{FP}	m	11.87
Equivalent Level Keel Draft	T_{MEAN}	m	12.37
Trim by Stern		deg.	0.19
Displacement	Δ	tonnes	122159
Centre Gravity Above Baseline	CG	m	18.0
Transverse Metacentric Height	GM_T	m	3.34

The natural periods in heave, pitch and roll of the free-floating (unmoored) FPSO were measured. The natural surge, heave, pitch and roll periods of the moored model were also measured. All the natural periods were measured using the Qualisys Optical Tracking System (QOTS). The natural periods for the free-floating and moored FPSO model are summarized in Table 4.2. Appendix 8, Qualification and Decay Tests, contains the graphical presentation of the FPSO surge, heave, pitch and roll characteristics.

Table 4.2 – Summary of Natural Periods for Free-Floating and Moored FPSO

FPSO Condition	Natural Period	Free-Floating	Moored
BL	Heave	9.56	*
BL	Pitch	9.08	9.48
BL	Roll	23.72	22.20
BL	Surge	-	105.3

* Note: No valid data collected during testing.

4.2 Totally Enclosed Motor Propelled Survival Craft (TEMPSC)

The model TEMPSC was representative of a typical 80-person craft. The model was fitted with two mechanical releases for the twin falls. For the modified system, a hook was added to the forward davit release block for attachment of the tagline ring.

The TEMPSC model was fabricated in two halves (hull and canopy) from GRP. The hull and canopy mated along the gunwale line. A rubberized gasket was used between the two to prevent water ingress. The model hull was fitted with a working rudder, rudder servo, 18 mm three-bladed propeller, shaft, DC motor, motor controller, receiver unit, rechargeable battery pack, accelerometer, and simulated hydrostatic interlock release unit. The hydrostatic release unit was modeled by inserting four brass pins (bow, stern, port and starboard at midships) at an equivalent full-scale height above baseline of approximately 0.5 m. In order for the TEMPSC blocks to be given the open command, an electronic circuit had to sense that at least three of the pins were submerged. The circuit also activated a light positioned on the TEMPSC canopy that served as a visual trigger for the operator to open the block. This arrangement ensured that no accidental opening of the blocks was possible and modeled an "On-Load" system with hydrostatic interlock. The TEMPSC was tested in the equivalent full load condition. No attempt was made to model fenders and other associated equipment. The accelerometer was mounted on the keel and oriented such that it recorded lateral accelerations. The canopy was fitted with a servomotor that activated the forward and aft falls release mechanism and opened the flexible boom hook safety.

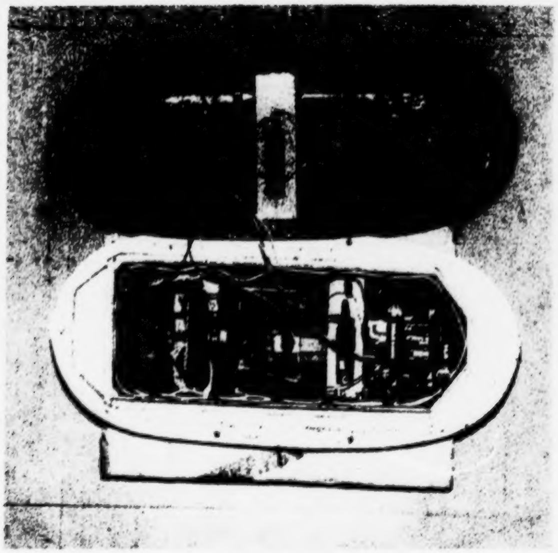

Figure 4.4 – TEMPSC Canopy and Hull

Figure 4.5 – Side View of the TEMPSC Model

Reflective tape was attached to the canopy at several locations for use with the QOTS. The instrumentation on the hull portion of the TEMPSC was used for the steering, propulsion and acceleration, while the instrumentation on the canopy was used to activate the flexible boom hook and release mechanisms. The complete systems are explained in detail in Appendix 3.

The TEMPSC speed was determined by averaging the time required by the model to travel a distance of 20 m. The TEMPSC model speed trials were conducted in the towing tank in calm water with the model in its test configuration and load condition. An average speed of 5.94 knots (full scale) was achieved, which is slightly below the target of 6 knots that is required by international regulations (*IMO 1997*). For repeatability purposes the calm water speed tests were repeated twice. The overall TEMPSC forward speed was programmed into the controller.

The hydrostatic properties and hull data are summarized in Appendix 3. The vertical centre of gravity (VCG) and radii of gyration were obtained by swinging the TEMPSC model hull on a frame in air. Results of the swinging are presented in Appendix 3.

Table 4.3 – TEMPSC Hydrostatics and Mass Properties

Totally Enclosed Motor Propelled Survival Craft			
Condition	FL		100%
Length Overall	LOA	m	9.80
Length on Water Line	L_{WP}	m	9.80
Beam	B	m	3.30
Trim by Stern		deg.	0.78
Displacement	Δ	tonnes	11.0
Centre Gravity Above Baseline	CG	m	1.37
Transverse Metacentric Height	GM_T	m	0.71

4.3 Deployment System

The deployment system for the FPSO is classified as a semi-wet evacuation system and is characterized by two main components, namely, the evacuation craft and the system that launches it. Modifications were made to the launch system consisting of the addition of a flexible boom. Details of the modified system are described in Section 4.3.2.

4.3.1 Twin Falls Davit

The twin falls davit system was of the straight fall double wire category with a TEMPSC stowed and launched parallel to the hull. The basic test setup is shown in Figure 4.6.

The deployment clearance of the TEMPSC from the FPSO was 1.5 times the breadth of the TEMPSC, ≈5.5 m full-scale; the launch height was ≈27.0 m above the still water surface. All tests were done with the TEMPSC at 100% load condition. The davit system main components are the winch drum for cable storage, the winch brake for controlling the speed of descent, and the cables themselves. Cable properties such as diameter, breaking strength, stiffness, etc. were not modeled; however, cable length was.

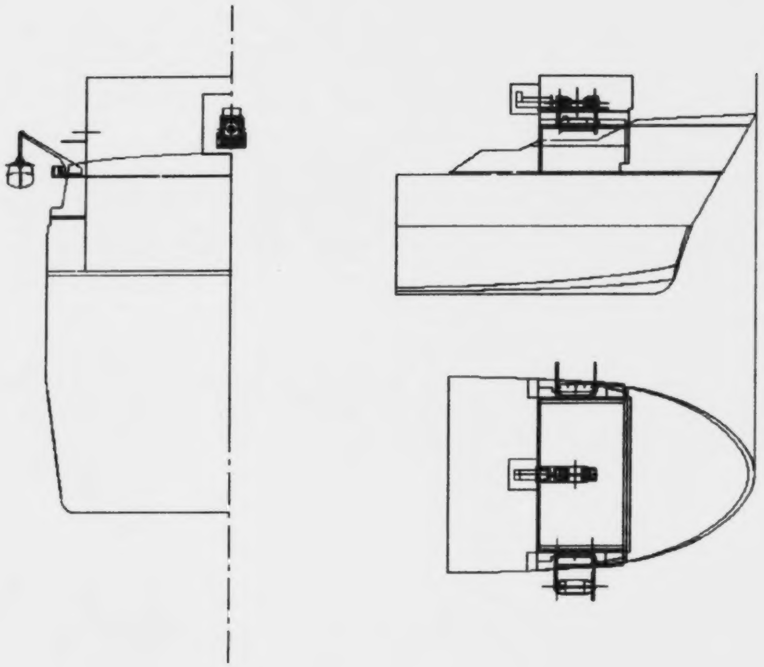

Figure 4.6 – Twin Falls Davit System Setup

The rate of descent of the TEMPSC was controlled by programming the DC motor controller to spool out cable from the winch drums at a full-scale rate of 53.6m·min^{-1}. The lowering speed was obtained from the following formula:

$$S= 0.4+ 0.02H \qquad (1)$$

Where, *S* is the lowering speed in metres per second and *H* is the height in metres from the davit head to the still water line at the lightest seagoing condition (IMO 1997b, Regulation 41, General requirements for lifeboats, Lifeboat propulsion, page 342).

Swivels were attached to the TEMPSC end of the davit cables. These were in turn fitted into the pins of the release blocks located at the bow and stern of the TEMPSC model. The pins of the release blocks were linked to a servomotor fitted in the TEMPSC canopy and activated from the side of the tank by a radio controller. Release of the forward and aft cables was simultaneous; no problems were encountered with the system.

4.3.2 Flexible Boom

The modified launch system consisted of a flexible boom held by a saddle support and a set of hinges attached to a base plate. The modified test setup is shown in Figure 4.7.

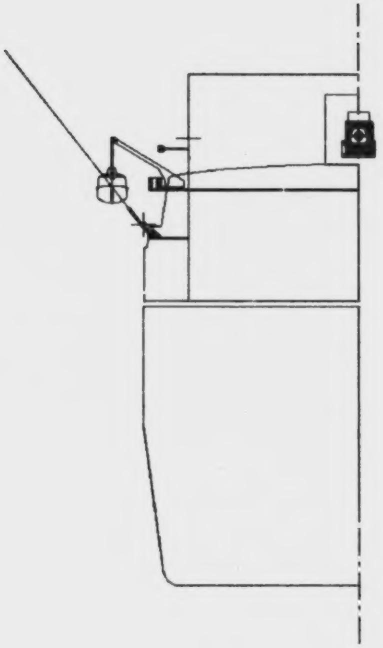

Figure 4.7 – Flexible Boom Deployment System Setup

The base plate was mounted approximately 2.5×TEMPSC height (316.5 mm) below the embarkation deck, ⅛×TEMPSC length (45.6 mm) forward of the forward davit arm, and ½×TEMPSC beam (66.5 mm) from the bulwarks. The hinges had a horizontal axis, allowing the boom to move in a vertical plane with a swing of about 75°. The boom length (≈868 mm) was about the same as the vertical distance from the TEMPSC launching position to the calm water surface for the FPSO at the ballast draft. The boom support was provided by an electronic spring controlled by a feedback loop of ram extension versus load. The boom was parked at an angle of 40° with respect to the baseline. A fixed length of line, or tagline, was attached at one end to the tip of the boom and at the other end to a metal ring. The ring fitted over the boom hook attached at the bow of the TEMPSC forward of the davit release block. The length of the tagline was set at about the same length as the boom itself.

In a deployment, as the TEMPSC is lowered by the davit falls, tension is generated on the tagline, causing the boom to rotate at the base and bend throughout its length until the falls are released. The TEMPSC is then pulled through the water by the tagline away from the FPSO and as it passes under the boom tip the tagline releases. The pulling motion is generated by the hydraulic pressure build-up in the hydraulic cylinder attached to the saddle. In the model version, this was accomplished via a controlled servo-motor that was calibrated to behave in the same fashion as the full-scale system. The hydraulic cylinder pulls the boom upwards, causing the TEMPSC to be pulled in an outward direction away from the FPSO. During deployment and prior to the release of the TEMPSC from the davit falls, the tagline changes the heading of the TEMPSC away from the FPSO and stabilizes the TEMPSC as it is being lowered to the water surface. The stabilization of the TEMPSC reduces the pendulum effect observed in traditional twin davit falls systems.

Adequate scaling of the boom components was achieved. Boom tip deflection as well as ram extension and load were scaled according to information obtained from full scale. Table 4.4 together with Figures 4.8 and 4.9 show the modeled results. Boom deflection experiments were carried out with the boom in a horizontal position with loads applied at the 734.2 mm mark.

Table 4.4 – Flexible Boom Tip Deflection and Servo Motor Extension with Load

Applied Load (g)	**Tip Deflection (mm)**	**Extension (mm)**	**Load (g)**
9.5	238	5.72	795.1
18.9	392	10.47	1052.0
28.4	490	15.75	1256.9
37.8	550		
47.3	590		
56.8	615		
66.2	635		
75.7	652		
85.2	665		
94.6	675		

All the cables associated with the system (i.e. falls and tagline) did not have their properties such as stiffness, diameter, etc. scaled; however, the cable and tagline lengths were scaled.

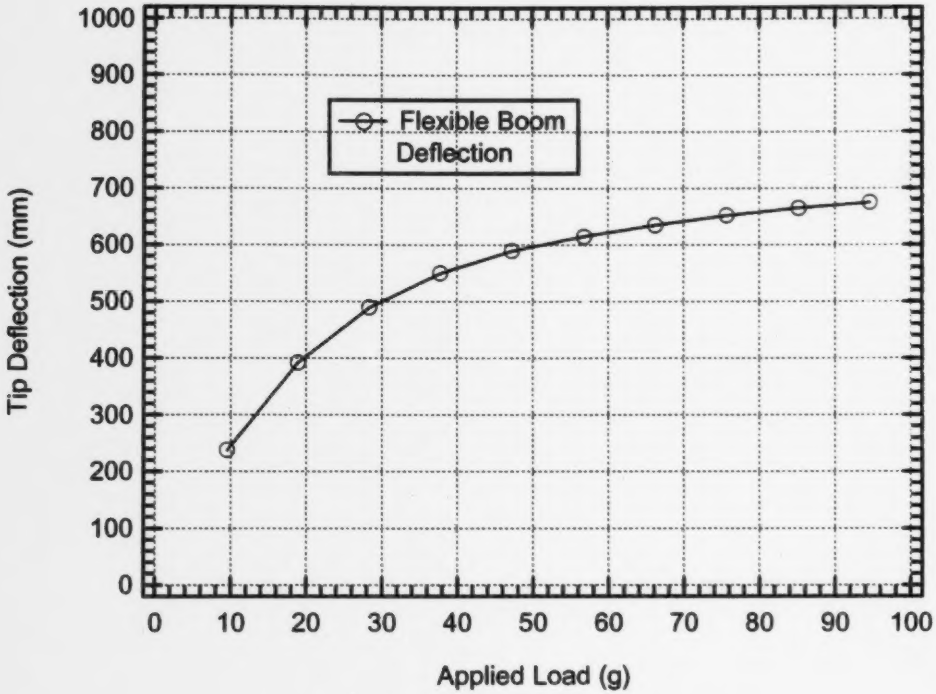

Figure 4.8 – Flexible Boom Tip Deflection

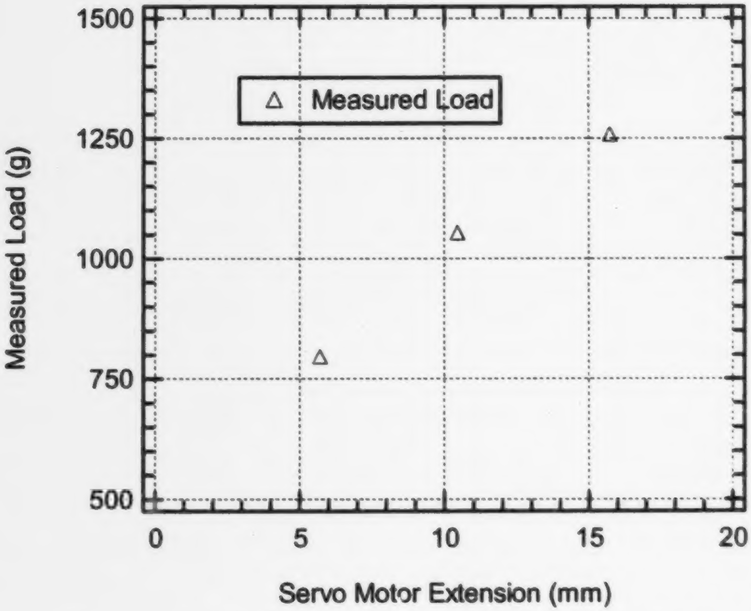

Figure 4.9 – Servo Motor Extension for Applied Load

5.0 ENVIRONMENTAL MODELS

The IMD OEB has a nominal working area of 65 x 26 m with a working depth of 3 m. The OEB is fitted with 168 individual wavemaker segments, hydraulically activated and distributed in an "L" shape around its perimeter. The wavemakers are capable of generating multi-directional irregular waves of 0.5 m significant wave height. A general layout of the OEB is presented in Appendix 1.

A layout of the basin showing the direction of the waves, wind and the positioning of the FPSO is also presented in Appendix 1.

This series of experiments required the generation of different environments consisting of waves and wind. The wave modeling concentrated on the matching of the wave height and period while the wind modeling concentrated matching a mean wind speed. The wave matching was performed without the model in the basin, while for the wind speed calibration the FPSO model was on its moorings. The required quantities were adjusted by iteration to the desired settings and the control signals recorded for playback during the test.

Table 5.1 summarizes the full-scale environmental conditions for the waves and wind. Appendix 6 contains the details and results of the environmental calibrations. Sections 5.1 and 5.2 discuss specific aspects of each environmental element.

Table 5.1 – Environmental Conditions

		WAVES			WIND	
Environment	Beaufort Scale	Height (m)	Period (s)	Direction (Degrees)	Velocity (m/s)	Direction (Degrees)
A	(0) Calm Water	0.00	0.00	200	0.00	143
B	(4) Moderate Breeze	1.01	5.60	200	7.20	143
C	(5) Fresh Breeze	2.10	7.70	200	9.77	143
D	(6) Strong Breeze	3.96	9.90	200	12.60	143
E	(7) Moderate Gale	6.71	12.10	200	15.43	143
F	(8) Fresh Gale	11.28	14.90	200	19.03	143

5.1 Regular Waves

Wave simulation at IMD is provided by a multi-segmented, hydraulically powered, paddle-type wavemaker. Regular waves can be generated as well as short crested or long crested waves. Wave direction can be varied from zero to 90° in the basin.

The test program required the generation of five regular waves. The waves were initially matched on wave height and period without the FPSO model in the basin. For each matched wave, a segment of 20 cycles was chosen to evaluate the wave parameters. The 20-cycle segment was selected by windowing through the entire time trace.

The following criteria were applied to each segment selected:

A. $\textit{Deviation from Height Target} = \frac{|(H_{Avg} - H_{Target})|}{H_{Target}}$ <5%

B. $\textit{Wave Height Stability} = \frac{(H_{Max} - H_{Min})}{H_{Avg}}$ <5%

C. $\textit{Wave Crest Stability} = \frac{(C_{Max} - C_{Min})}{C_{Avg}}$ <2.5%

The selected segments were examined to ensure they were within the target tolerances. All five waves used in the test program met the three criteria.

During testing the wave signal was also recorded but due to reflections from the model, this may not have exactly mimicked the calibrated wave.

The waves were regular waves run with the basin in flume mode and with a 160° direction (180° – head seas). The files were defined using the following naming convention:

REG_HαPα_TβPβ_00δ

Where:

REG - indicates regular waves
H - denotes wave height
T - denotes wave period
P - defines the decimal place
α - defines the significant wave height in metres
β - defines the wave period in seconds
δ - defines the incremental matching attempt number

For example, the run designated:

REG_H3P96_T9P90_002

defines a regular wave with a wave height of 3.96 m, a period of 9.90 seconds and a matching attempt number of 2. The entire wave matching for the test series is contained in Appendix 6.

Table 5.2 – Summary of All Wave Files

			WAVE CRITERIA		
	H	T	Height		Crest
DESCRIPTION	(m)	(s)	Target (5.0%)	Stability (5.0%)	Stability (2.5%)
REG_H1P01_T5P6_001	1.01	5.60	0.59	3.31	2.04
REG_H2P10_T7P7_002	2.10	7.70	1.79	2.34	1.39
REG_H3P96_T9P9_002	3.96	9.90	0.89	1.08	0.59
REG_H6P71_T12P1_002	6.71	12.10	0.67	1.78	0.81
REG_H11P28_T14P9_002	11.28	14.90	2.49	1.09	1.09

5.2 Wind

Wind was simulated using a horizontal array of 12 analog-controlled fans mounted on support frames. The fans were positioned such that the wind direction was 37° to the FPSO heading and at a distance of 7.70 m from the FPSO turret centre. Each fan, with a blade diameter of 530 mm, was powered by a DC motor, capable of rotating at speeds of up to 5000 rpm. The wind generator can produce a turbulent wind spectrum with a mean wind speed of 12 m/s. For installation and operating procedures refer to Fudge and McKay (1995).

The wind speed was modeled in terms of mean speed and was calibrated prior to the test program with the FPSO model installed. The fans were run at a steady speed and adjusted so that at a distance of 7.70 m, the mean wind speed was the one specified in the test program.

The accommodation module adjacent to the deployment zone was an accurate representation of a prototype; however, the structures aft of this module were not modeled. The wind loading on these superstructures would not affect the TEMPSC deployment.

6.0 INSTRUMENTATION

Instrumentation for the models consisted of the following:

- One QOTS to provide six degrees of freedom motions of the FPSO model with respect to the earth fixed coordinate system (see Section 6.2),
- One anemometer to provide information on wind speed in the area of TEMPSC deployment,
- A second QOTS to provide TEMPSC X-Y-Z motion during deployment and sail-away,
- One accelerometer to record TEMPSC lateral accelerations,

- A miniature load cell to provide feedback on the modeled hydraulic system load versus extension,
- A motor controller to provide accurate davit pay-out rates,
- An electronic switch identifying the davit release time,
- Two capacitance wave probes (one upstream and one beam of the FPSO) to give feedback on the wave environment.

A summary of the instrumentation calibration used throughout the tests is presented in Appendix 7.

Video records of the tests were recorded with four fixed video cameras and a hand-held one. Still photographs were taken with 35 mm and digital cameras. The fixed video cameras were located in the following locations:

- One black-and-white camera mounted on the FPSO capturing the start of TEMPSC descent, splashdown and sail-away;
- A ceiling-mounted camera providing a bird's-eye view of the entire process;
- One camera mounted on the side of the basin providing a beam view of the tests;
- One camera mounted on the wind machine looking into the FPSO and providing a view of the evacuation zone.

The QOTS tracked an irregular array of reflective spheres mounted on a vertical support at the bow of the FPSO model to measure the six-degrees-of-freedom motions of the model with respect to an inertial coordinate system. An anemometer was mounted just aft of the davit arms to provide wind speed information in the area of the TEMPSC location. Four video cameras were used to track the TEMPSC from start of descent to splashdown and sail-away.

6.1 Data Acquisition

Data acquisition was made through three different systems, namely, Neff620-500, telemetry and video, and at two sampling frequencies. The NEFF and telemetry data were sampled at 50 Hz. The video data was sampled at normal recording speed of 30 frames per second. The NEFF system was shore based, while the telemetry was installed on the FPSO. The video was both FPSO and shore based.

The video acquisition system consisted of four VHS and SVHS video cameras. The cameras were installed at the locations stated in Section 6.0. All the cameras except the one on board the FPSO were attached to pan and tilt mechanisms controlled from the observation tower. These cameras had remotely controlled zoom and focusing. The camera on board the FPSO was mounted on a tripod that provided for some degree of adjustment. Any modifications to the focus had to be done manually. The video format of all the cameras was NTSC.

6.2 Coordinate System

The coordinate systems used in the analysis of this series of experiments can be defined as follows:

- Basin Coordinate System

  Global right-handed system with the origin at the centre of the turret at the main deck level at its rest position in calm water. The X-axis is defined as up the basin in the direction of the west wall wavemakers, the Y-axis is defined to port and the Z-axis upwards. Wave probe locations and wind machine locations are referenced to this system.

- FPSO Coordinate System

  FPSO fixed with origin at the turret centre. This coordinate right-handed system is fixed to the FPSO and moves with it. It defines location of instruments on the FPSO, embarkation zone, flexible boom and davits locations, electronic spring load, and payout.

- TEMPSC Coordinate System

  TEMPSC fixed with origin at the centre of gravity. This coordinate right-handed system is fixed to the TEMPSC and moves with it. It defines the location of the release mechanisms and other instruments, and lateral accelerations.

6.3 Measurement Error

Approximate measuring errors in model and full-scale units are summarized as follows:

Table 6.1 – Approximate Measuring Errors

DESCRIPTION	MODEL SCALE	FULL SCALE
Qualisys Linear Motions FPSO and TEMPSC	± 5 mm	±138.5 mm
Qualisys Angular Motions FPSO	± 0.5 degrees	± 0.5 degrees
Flexible Boom Electronic Spring Load	± 0.05 N	± 1.06 kN
Lateral Accelerations	± 0.1 m/s^2	± 0.1 m/s^2

7.0 QUALIFICATION TESTS

Qualification tests consisted of instrumentation calibration, post-test calibrations, and decay tests in which the models were offset and allowed to oscillate in still water to determine the natural oscillation periods and the damping of the free-floating and moored FPSO. Also included in this section are the verification tests conducted to ensure that the conditions in which the evacuation system was being used were representative of similar hulls in similar environmental conditions.

7.1 Calibrations

All analog sensors were calibrated before the start of the experiments. The response of the sensor to a set of exciting loads was measured and a straight line fitted through the data points by means of a least squares technique.

The line is defined by two constants *A* and *B*, which relate the integer analog-to-digital (A/D) converter reading (counts) to the physical quantities being measured according to the following linear transformation:

$$X = A(k) \times (M - B(k))$$

Where:

X = physical value in physical units,

M = integer A/D converter reading,

A(k) = sensitivity of the sensor connected to the A/D channel k in physical units per count, and

B(k) = Zero offset of the sensor connected to A/D channel k in counts.

The purpose of the calculation is to calculate the constants *A(k)* and *B(k)*, ensure that the sensor functions properly and has a linear response. The constant *A(k)* also represents the digital resolution of the measurement. The calibrated sensors are presented in Appendix 7.

7.2 Decay Tests

Decay tests were conducted for the free-floating (unmoored) and moored FPSO model. Heave, pitch and roll tests were conducted for the free-floating FPSO. The same tests plus surge decay were conducted on the moored FPSO. These experiments were performed prior to the start of the individual runs and were necessary to ensure that the respective periods for the FPSO vessel (i.e. roll, pitch, and surge) were realistic. A discussion of all the decay test results is presented in section 10.1 while the individual results are contained in Appendix 8.

7.3 Verification Tests

Verification tests were conducted on the FPSO model to ensure that the motions with the simplified mooring configuration setup were representative of an FPSO. The FPSO model was run through the five environments specified in Section 5.1. With the waves, the aim was to match the wave height and period. Wind was matched for a specified mean speed at a nominal distance of 7.70 m model scale (i.e. distance between the wind machine and the turret centre).

The verification experiments were conducted for the FPSO in its test configuration prior to the start of the evacuation system assessment. Results of the individual tests are contained in Appendix 8.

8.0 TEST PROGRAM

The experiment program consisted of nine series of tests. The basic twin falls davit launched system was used in the first six series; a flexible boom was used in the last three series. All of the launch configurations started with the TEMPSC parallel to the platform. The only variable in the test program was the environmental condition (i.e. waves and wind). Table 8.1 shows the nominal description of the environmental conditions, from calm water to fresh gale, and the planned and actual (full-scale) mean wave heights and wind speed.

As one of the aims of the tests was to evaluate the use of the model tests and experimental methods themselves, each type of test was to be repeated 20 times. In actuality this number varied from 14 to 20. This provides an indication of the variability of the tests, which may help interpret the importance of particular random variables, such as the splashdown point on the wave (e.g. crest, trough).

Table 8.1 – Test program

SERIES LABEL	NUMBER OF RUNS		BEAUFORT DESCRIPTION	MEAN WAVE (m/s)		MEAN WIND (m/s)	
	Plan	Actual		*Plan*	Actual	*Plan*	Actual
CONVENTIONAL TWIN FALLS DAVIT CONFIGURATION							
400	*20*	14	(0) Calm water	*0.00*	0.00	*0.00*	0.00
500	*20*	20	(4) Moderate breeze	*1.01*	0.88	*7.20*	6.27
525	*20*	19	(5) Fresh breeze	*2.10*	2.05	*9.77*	8.11
550	*20*	15	(6) Strong breeze	*3.96*	3.90	*12.60*	10.13
600	*20*	14	(7) Moderate gale	*6.71*	6.16	*15.43*	12.20
625	*20*	14	(8) Fresh gale	*11.28*	10.76	*19.03*	15.34
FLEXIBLE BOOM CONFIGURATION							
700	*20*	20	(0) Calm water	*0.00*	0.00	*0.00*	0.00
725	*20*	19	(5) Fresh breeze	*2.10*	1.93	*9.77*	8.32
800	*20*	19	(8) Fresh gale	*11.28*	10.84	*19.03*	16.15

8.1 Test Methodology

The methodology used throughout the nine different tests series can be summarized as follows:

Verification Tests

- Ballast the FPSO to the required load condition.

- Perform inclining experiment to check the metacentric height of the FPSO.
- Perform heave, pitch and roll decay experiments on the free-floating FPSO.
- Attach the FPSO to the horizontal mooring.
- Perform surge, heave, pitch and roll decay experiments on the moored FPSO.
- Perform a check run, followed by the activation of the current.
- Start the data acquisition system followed by the wavemakers and the wind machine. Activate the video recording system. Run wind and waves continuously for 2-3 minutes.
- Stop the data acquisition, the waves, the wind and the video recording system.

Offshore Evacuation System Tests

These experiments were conducted after the verification tests, which meant that the FPSO load condition was set and the only variants were environment and the TEMPSC deployment system.

- The moored and tethered FPSO was set according to the test matrix.
- The twin falls davit lines were winched up to the bulwark deck level.
- The TEMPSC was attached to the twin falls davit. For the experiments with the flexible boom the tagline was attached to the TEMPSC flexible boom hook.
- The TEMPSC was winched up to the proper launching height. This was accomplished by installing a limit switch that cut power to the winch when it was contacted by the TEMPSC.
- The member of the project team in charge of the TEMPSC setup moved away from the test area to the north side of the basin.
- The data acquisition was started, followed by the wavemakers, the video and the wind machine. After approximately 10-15 wave cycles passed the FPSO, the command to start deployment was given. The basin operator tried to keep deployments as random as possible.
- After the signal was received, the deployment started. Halfway between the TEMPSC launching rest position and the water surface, the TEMPSC propulsion system was started remotely.
- After splashdown the davit releases were activated. For experiments using the flexible boom, the TEMPSC hook safety opened and after the tagline released the TEMPSC sailed away towards the safe zone. During the sail-away the TEMPSC rudder control was not activated.
- The wavemakers, video and wind were stopped and the run considered terminated. At this time the TEMPSC was manoeuvred back to the FPSO for pickup.

- After a few minutes the members of the project team started preparation for the next run. The time between test runs was set to 10 minutes.

Successful runs were defined as those for which a release of both davit lines and flexible boom tagline released and the TEMPSC sailed away from the FPSO. Deployments were such that splashdown occurred on different portions of the wave, i.e. wave trough, crest, up and down slope.

8.2 Test Matrix

The test program was conducted as per plan with last minute modifications as the tests proceeded. Tables 8.2 and 8.3 detail the tests conducted for the verification test series and the offshore evacuation systems test series.

The verification tests series was conducted on the FPSO model to ensure that the motions with the simplified mooring configuration setup were representative of similar hull forms on a mooring. The experiments took place prior to the start of the evacuation system assessment. The test matrix is presented in Table 8.2.

Table 8.2 – Verification Tests Matrix

FPSO		WAVE CONDITION		
Condition	Test Name	H (m)	T (s)	Direction (deg.)
BL	T913_300_001	1.10	5.60	200
BL	T913_301_001	2.10	7.70	200
BL	T913_302_001	3.96	9.90	200
BL	T913_303_001	6.71	12.10	200
BL	T913_304_001	11.28	14.90	200

The test matrix for the evacuation system assessment was broken down into two major components. The first consisted of six test series for the basic twin falls davit launched system while the second consisted of three test series for the flexible boom. All of the launch configurations started with the TEMPSC parallel to the platform and the only variable was the environmental condition. Table 8.3 presents the test matrix.

Table 8.3 – Offshore Evacuation System Test Matrix

FPSO	TEMPSC	SYSTEM	WAVE CONDITION		WIND	DESCRIPTION	
Condition	Condition		H (m)	T (s)	Veloc. (m/s)	Series Number & Name	No. Tests
BL, I, B20	W, P	Davit	0.00	0.00	0.00	400, Calm Water	20
BL, I, B20	W, P	Davit	1.01	5.60	7.20	500, Moderate Breeze	20
BL, I, B20	W, P	Davit	2.10	7.70	9.77	525, Fresh Breeze	20
BL, I, B20	W, P	Davit	3.96	9.90	12.60	550, Strong Breeze	20
BL, I, B20	W, P	Davit	6.71	12.10	15.43	600, Moderate Gale	20
BL, I, B20	W, P	Davit	11.28	14.90	19.03	625, Fresh Gale	20
BL, I, B20	W, P	Boom	0.00	0.00	0.00	700, Calm Water	20
BL, I, B20	W, P	Boom	2.10	7.70	9.77	725, Fresh Breeze	20
BL, I, B20	W, P	Boom	11.28	14.9	19.03	800, Fresh Gale	20

Definitions:

BL – Ballast Load
B20 – 20° FPSO heading
W – Windward deployment
Davit – Twin falls davit system

I – Intact
P – TEMPSC power
Boom – Flexible boom system

9.0 RESULTS

Results from each test were recorded in model-scale units and checked at the time of testing. Some basic analysis was performed with statistics generated for each channel. These results were treated as preliminary results.

Results presented in this report have been translated to full-scale values for salt water and have been re-analyzed to provide event statistics for the FPSO motions, TEMPSC deployment, falls and tagline release. Results of the verification experiments, in addition to being translated to salt water and full-scale values, were also re-analyzed to provide both detailed statistical results and response amplitude operators (RAO). The RAOs were obtained from the double amplitude of motion divided by the wave height.

Detailed results are presented in Appendix 9 for individual experiments. The individual tests contain the FPSO motions, TEMPSC deployment, falls and tagline release event statistics followed by detailed statistical and RAO results for the verification experiments.

9.1 Data Analysis and Techniques

Sections 9.1.1 to 9.1.5 describe the techniques used to analyze the test data. In some cases packaged software was used, while in others, task specific software was developed for this program.

9.1.1 Statistical Analysis

For each measured and calculated time series the following parameters are calculated and output:

- Mean value of the time series: $\bar{x} = \frac{1}{N}\sum_{i=1}^{N} X_i$
- Minimum value
- Maximum value
- Standard Deviation: $\sigma = \sqrt{\frac{1}{N-1}\sum_{i=1}^{N}(X_i - \bar{x})^2}$
- Variance: σ^2

where: N is the total number of samples in the time series, and
X_i is a discrete sample of the time series.

9.1.2 Zero-Crossing Analysis

A zero-crossing analysis (ZCA) is performed on the time series data using a GEDAP program. The software checks the time spacing of the signal to ensure that the sampling rate is high enough to accurately perform zero crossing analysis. The software is designed primarily for wave elevation records but it may be used to analyze other types of data such motions and forces. The ZCA performs both zero up- and down-crossings, and calculates parameters that are defined for each individual cycle in the record as well as parameters that apply to the entire record.

9.1.3 Response Amplitude Operators

The FPSO motions are presented as Response Amplitude Operators (RAOs) for the six degrees of freedom. The average values of surge, sway, heave, yaw, pitch and roll are divided by the average wave height and the results plotted as functions of the respective wave period. In the case of the linear motions the RAO has units of m/m while for the angular motions the units are deg/m.

9.1.4 Deployment Analysis

This type of analysis was performed during the test program to ensure that the instrumentation was working properly. Data products produced by this type of analysis constituted time series and statistical summaries for the entire launching window as well as the following intervals: (a) start of deployment to splashdown, (b) splashdown to davit release/tagline release, and (c) davit/tagline release to open sea. Environment data (i.e. wind and waves), FPSO motion data, electronic spring load, boom position, davit payout, TEMPSC release, lateral acceleration and X-Y-Z position data were analyzed. In the time series plots, the davit release along with the tagline release were clearly marked and used to determine the local conditions at the time of release. FPSO motions, wave conditions and TEMPSC X-Y-Z were extracted at the above referred times. Synchronization between the acquisition systems, the shifting due to condition changes, etc., was handled during this analysis. Synchronization between the FPSO motion channels (data collected on the Neff) and flexible boom load, davit payout, etc. (data collected on Telemetry) was accomplished through synchronization channels, one on each system. The synchronization between the TEMPSC X-Y-Z data and the other data was accomplished with software and manual manipulation.

9.1.5 Event Analysis

This type of analysis, as the name indicates, was used to determine the sequence of events from the lowering, splashdown and sail-away phases of individual experiments. The data is transformed from an earth-fixed coordinate system to a FPSO-fixed coordinate system with its origin at the centre of gravity of the TEMPSC canopy. Generally speaking the data is presented in plan view, view along the centreline of the TEMPSC and outboard profile view. In each view the path taken by the TEMPSC is shown as an uneven line.

In the plan view, the outline of the TEMPSC is shown in its deployed position prior to lowering, which is used as a reference position. A pair of axes is centred at its midpoint. The waterline of the FPSO hull is also shown. Outboard of the FPSO the water surface is divided into three regions: a danger zone, an intermediate zone, and a safe zone. The danger zone is the area bounded by a 12.5 m radius from the TEMPSC's reference position and extending 6.6 m outboard from the FPSO's waterline. The region outside a 25 m radius is the safe zone, and the circular band between the danger and safe zones is the intermediate zone.

These boundaries have been drawn somewhat arbitrarily but represent areas for which TEMPSC target drop point, davit falls release, flexible boom tagline release, sail-away and others have measurable values.

This type of analysis allows for the estimation of TEMPSC lowering, sail track with respect to the FPSO and getaway time.

10.0 DISCUSSION AND RESULTS

This series of model experiments, conducted on the evacuation systems installed on the FPSO, measured the motions of the FPSO, the X-Y-Z position of the TEMPSC and its relative position to the FPSO. In addition, measurements of the TEMPSC lateral accelerations, flexible boom load, davit release and payout were made together with measurements of wave and wind.

Results from this test program are contained in the appendices and are grouped according to the following:

- Systems calibration tests (series 200)
- FPSO motion verification tests (series 300)

- TEMPSC deployment from FPSO in intact ballast load condition at 20° heading to the waves and 57° to the wind using the twin falls davit system (series 400, 500, 525, 550, 600, 625)
- TEMPSC deployment from FPSO in intact ballast load condition at 20° heading to the waves and 57° to the wind using the flexible boom deployment system (series 700, 725, 800)

For each of the above test series the only variable was the environment. FPSO, TEMPSC and deployment conditions were kept constant. This section is structured to address general observations on the different types of experiments performed on the overall test program.

10.1 Systems Calibration (200 Series)

This series of tests was aimed at establishing the natural periods of the FPSO model in the free-floating and moored configurations. Inclining experiments for the FPSO in the ballast load condition as well as TEMPSC speed tests were also included in this series. The natural periods for the free-floating and moored FPSO are summarized in Table 10.1.

Table 10.1 – Comparison of Natural Periods for Free-Floating and Moored FPSO

FPSO Condition	Natural Period (s)	Free-Floating	Moored
BL	Surge	-	105.30
BL	Heave	9.56	-
BL	Pitch	9.08	9.48
BL	Roll	23.72	22.20

The only periods for which a comparison can be made are the pitch and roll. They show that by mooring the vessel, the pitch period increases slightly and the roll period decreases. The slight increase in pitch is an unexpected result; however, the values are close and the possibility of error in the decay analysis is large given that the values are attained from one or two cycles. A comparison is also made in Table 10.2 between the values attained for the FPSO used in this test program and other similar vessels.

Table 10.2 – Comparison of Natural Periods for FPSO and Similar Vessels

Natural Period (s)	Generic FPSO	FSO	FPSO	Tanker
Surge	105.3	-	285.00	-
Heave	9.56	13.00	11.00	-
Pitch	9.08	12.00	10.00	8.30
Roll	23.72	14.00	11.00	9.40

The above values show that the generic FPSO used in the experiments had heave and pitch periods similar to other hulls; however, it is clear that the both the surge and roll periods are quite different. TEMPSC deployments are not expected to be adversely affected by the differences in either surge or roll natural periods.

The results of the inclining experiments for the generic FPSO used in the tests are compared to other GM_T values obtained from similar vessels. The results from the two FPSOs are comparable but the results from both the Floating Storage Offloading (FSO) and tanker are quite different. This may be explained by the difference in the types of operation and also from the fact that many of the current FSOs are in essence converted tankers. This explains the similarity in the FSO and tanker metacentric height values.

Table 10.3 – Comparison of Metacentric Heights (GM_T)

	IMD FPSO	FSO	FPSO	Tanker
GM_T (m)	3.34	8.84	3.90	7.83

The TEMPSC speed calibration consisted of multiple runs in calm water over a 20 m distance (model scale). Once the proper speed was attained, a set point was established on the controller for speed repeatability purposes.

The vertical and longitudinal centres of gravity of the TEMPSC used throughout the tests series were estimated by swinging it in air. The TEMPSC was attached to the swinging beam at the location of the longitudinal centre of gravity and weights adjusted until it balanced in the forward and aft directions. This started the process to determine the VCG. The restoring moment and mass moment of inertia of the beam, TEMPSC and weight were determined and the VCG estimated. The TEMPSC displacement was approximately 100% of loaded condition. In Table 10.4 the values attained by swinging are compared to values from comparable designs. The TEMPSC and swinging beam are shown in Appendix 3.

Table 10.4 – Comparison of Non-dimensional Longitudinal and Vertical Centres of Gravity

	TEMPSC IMD	TEMPSC RIT	TEMPSC Conventional	TEMPSC Freefall
LCG	0.42	0.48	0.42	0.49
VCG	0.39	0.35	0.36	0.34

Note: IMD – Institute for Marine Dynamics RIT – Royal Institute of Technology

10.2 FPSO Motion Verification (300 Series)

FPSO motion verification tests were aimed at comparing the results of the FPSO model hull design and its setup used in this set of experiments to results of similar hull designs. The intent was also to demonstrate that the current model experiments produced realistic FPSO motions in the different environmental conditions for the evaluation of the offshore evacuation system.

Tests were conducted in five environments made up of waves and wind for the FPSO in its ballast loading condition with 20° heading to the waves and 57° to the wind. The environments corresponded to those proposed for the test series.

The results from the small waves and low wind produced little or no motions on the FPSO. Also, some of the data collected for this environment was very noisy, which made analysis difficult and very unreliable. A decision was made to omit this environment from the comparisons. The fresh and strong breeze along with the moderate and fresh gale environments will be used for the comparison of the resulting motions of the FPSO in the current setup.

The parameters for comparison will be the FPSO linear and angular motions. The average values of all the motions together with the average wave height of the matched wave will be used in the comparison. The RAOs were calculated by dividing the average of the motions by the average of the wave heights.

The comparison is made with results from the Offshore Engineering Handbook (OEH), FPSO-2 and IMD tanker. The results are tabulated in Table 10.5 and presented in Figures 10.1 and 10.2. The OEH results are only for heave and pitch, and there was no reference to the FPSO heading. The data for both the FPSO-2 and IMD tanker are for the same heading to the waves as the current tests but no reference is made of the wind direction. The comparison must therefore be made with the understanding that not all the parameters were the same; however, one can get a sense of the FPSO's overall performance.

Table 10.5 – Response Amplitude Operators Comparison

ENVIRONMENT 1		**RESPONSE AMPLITUDE OPERATOR**					
Vessel	T (s)	Surge (m/m)	Sway (m/m)	Heave (m/m)	Yaw (deg/m)	Pitch (deg/m)	Roll (deg/m)
FPSO	7.71	0.045	0.081	0.082	0.027	0.028	0.043
OEH FPSO	7.50			0.030		0.030	
FPSO-2	7.50	0.024	0.024	0.125	0.024	0.060	0.054
IMD Tanker	7.75	0.152	0.303	0.273	0.042	0.026	0.048
ENVIRONMENT 2		**RESPONSE AMPLITUDE OPERATOR**					
Vessel	T (s)	Surge (m/m)	Sway (m/m)	Heave (m/m)	Yaw (deg/m)	Pitch (deg/m)	Roll (deg/m)
FPSO	9.91	0.099	0.246	0.240	0.076	0.252	0.101
OEH FPSO	9.90			0.160		0.170	
FPSO-2	10.00	0.073	0.048	0.357	0.050	0.120	0.107
IMD Tanker	9.95	0.182	0.288	0.136	0.048	0.324	0.133
ENVIRONMENT 3		**RESPONSE AMPLITUDE OPERATOR**					
Vessel	T (s)	Surge (m/m)	Sway (m/m)	Heave (m/m)	Yaw (deg/m)	Pitch (deg/m)	Roll (deg/m)
FPSO	12.10	0.067	0.081	0.289	0.118	0.486	0.225
OEH FPSO	12.00			0.130		0.220	
FPSO-2	12.00	0.200	0.182	0.580	0.170	0.430	0.134
IMD Tanker	12.00	0.091	0.121	0.409	0.164	0.618	0.333
ENVIRONMENT 4		**RESPONSE AMPLITUDE OPERATOR**					
Vessel	T (s)	Surge (m/m)	Sway (m/m)	Heave (m/m)	Yaw (deg/m)	Pitch (deg/m)	Roll (deg/m)
FPSO	14.91	0.415	0.058	0.412	0.182	0.597	0.197
OEH FPSO	15.00			0.330		0.440	
FPSO-2	15.00	0.521	0.242	0.804	0.206	0.600	0.161
IMD Tanker	15.00	0.348	0.106	0.606	0.267	0.647	0.204

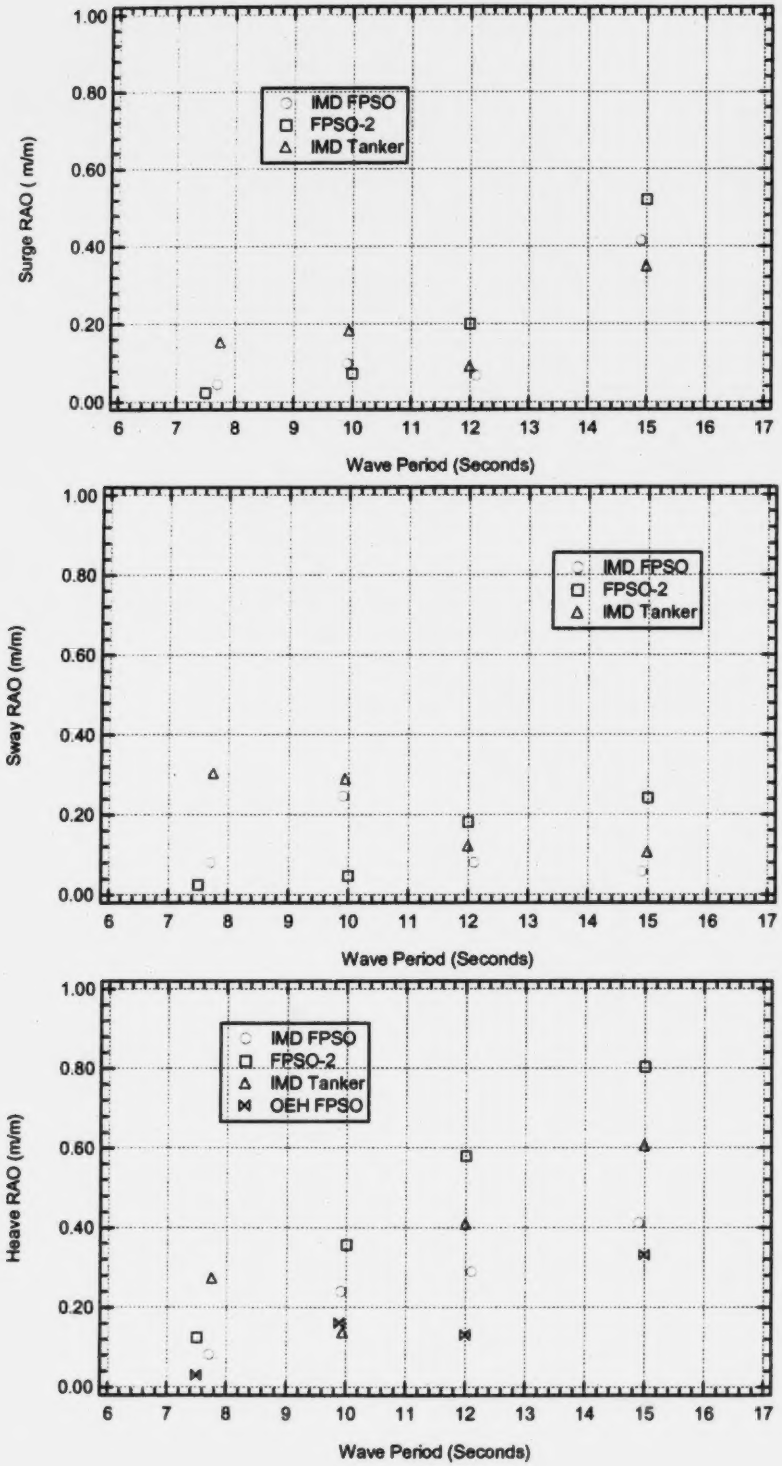

Figure 10.1 – Surge, Sway and Heave RAO Comparison

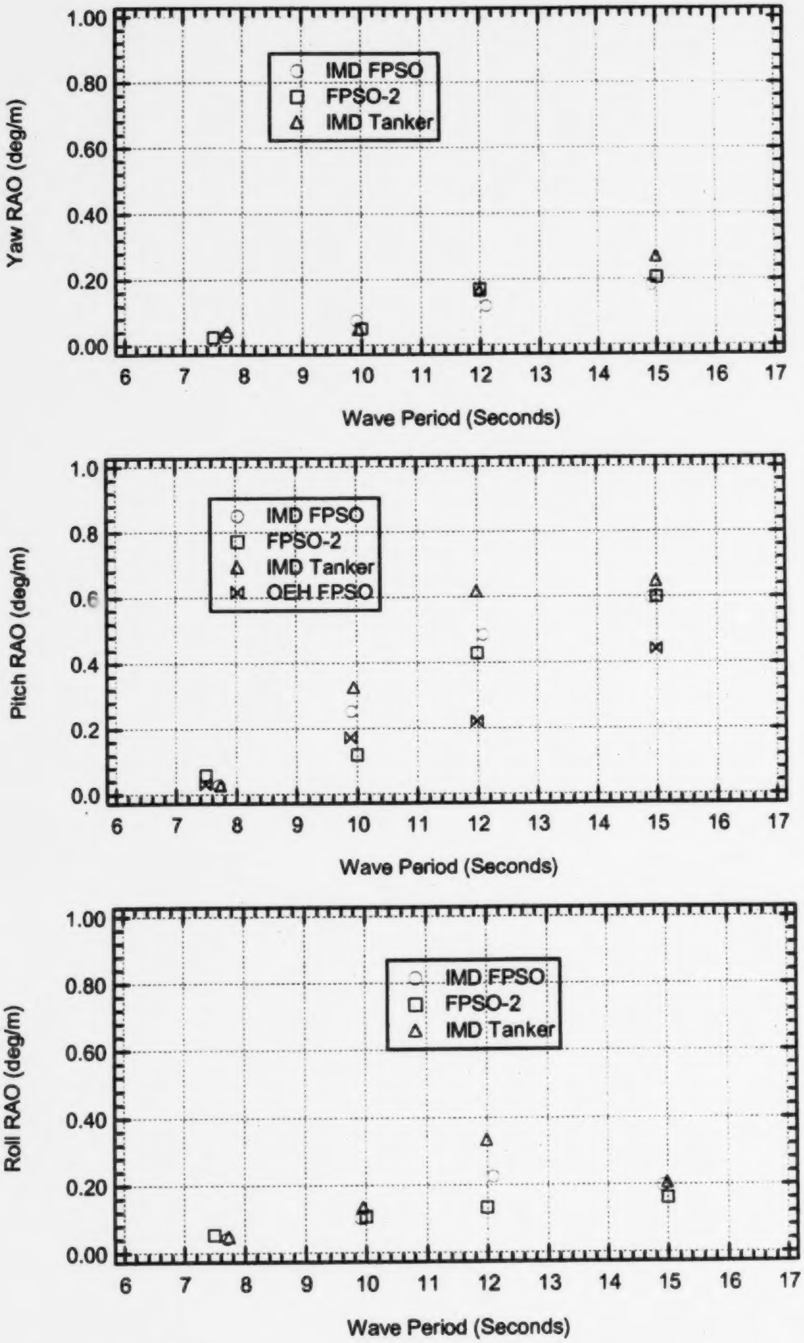

Figure 10.2 – Yaw, Pitch and Roll RAO Comparison

The results of the verification test indicate that the linear and angular motions of the FPSO are within the limits of similar hull forms. The IMD FPSO follows the same trends and in all the cases the recorded values are within the upper and lower limits presented for the other hull forms. This demonstrates that the FPSO hull form selected to conduct the offshore evacuation series of experiments is a valid platform representative of industry trends.

10.3 TEMPSC Deployment from FPSO – Twin Falls Davit System (Series 400, 500, 525, 550, 600, 625)

TEMPSC deployment from the FPSO with the twin falls davit evacuation system was one of the main objectives of the test program. Data collected for the FPSO, TEMPSC, evacuation system and environment conditions will be used to evaluate the overall performance of the system. The different series refer to TEMPSC deployments in:

400 series – Calm Water, 14 runs

500 series – Moderate Breeze, 20 runs

525 series – Fresh Breeze, 19 runs

550 series – Strong Breeze, 15 runs

600 series – Moderate Gale, 14 runs

625 series – Fresh Gale, 14 runs

The test program for the TEMPSC twin falls davit deployment has a total of 96 runs analyzed of a projected total of 120. The 24 runs that were not analyzed represent runs for which data quality was poor, data channels failed to work, or mechanical failures due to low battery power occurred.

The individual runs data for FPSO motions, TEMPSC location, wind and waves together with the detailed video analysis are presented in Appendix 9

10.3.1 400 Series – Calm Water
Twin Falls Davit System TEMPSC Deployment

The 400 series – calm water – deployments were performed for the FPSO in the intact condition. A total of 21 deployments were performed; however, the first seven were omitted from the presentation and analysis because the operator used excessive rudder angle. For these experiments no rudder angle data was collected so the radio controller was calibrated such that different notches on the controller corresponded to different rudder angles. This way the operator could consistently provide similar input to the rudder controller.

All of the tests were similar and can be described with reference to Figures 10.3 to 10.5, which illustrate the lowering, splashdown, and sail-away phases of a test in calm water. Figure 10.3 shows a plan view, Figure 10.4 is a view along the centreline of the TEMPSC, and the Figure 10.5 shows an outboard profile. In each view the path of the TEMPSC is shown as an uneven line.

In the plan view, the outline of the TEMPSC is shown in its deployed position prior to lowering, which is used as a reference position. A pair of axes is centred at its midpoint. The waterline of the FPSO hull is also shown. Outboard of the FPSO the water surface is divided into three regions: a danger zone, an intermediate zone, and a safe zone. The danger zone is the area bounded by a 12.5 m radius from the TEMPSC's reference position and extending 6.6 m outboard from the FPSO's waterline. The region outside a 25 m radius is the safe zone, and the circular band between the danger and safe zones is the intermediate zone.

During the calm water deployments the path of the TEMPSC is simple: it goes straight down during lowering, as indicated in Figures 10.4 and 10.5; upon splashdown into the danger zone it sails straight ahead through the intermediate zone to safety, as illustrated in the Figure 10.3.

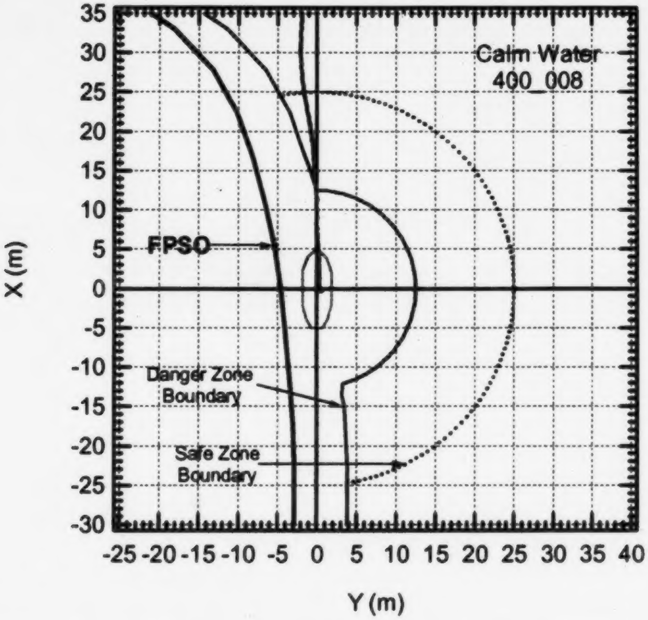

Figure 10.3 – Plan View of the Deployment

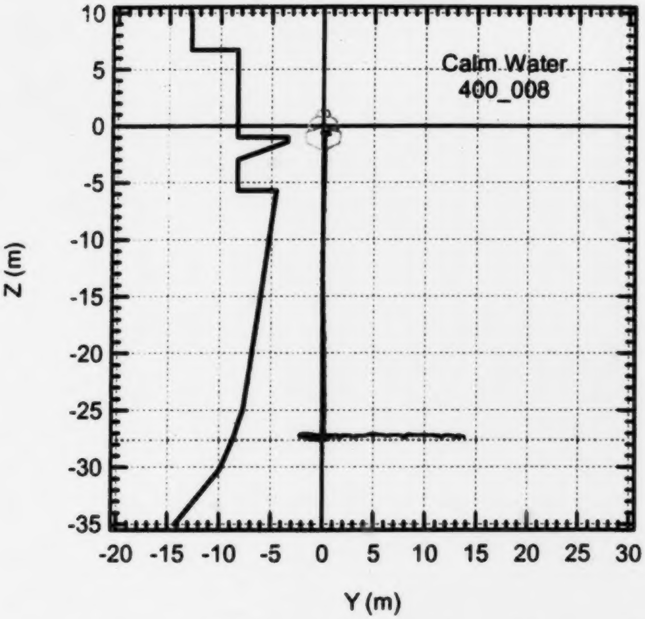

Figure 10.4 – View Along the Centreline of the TEMPSC

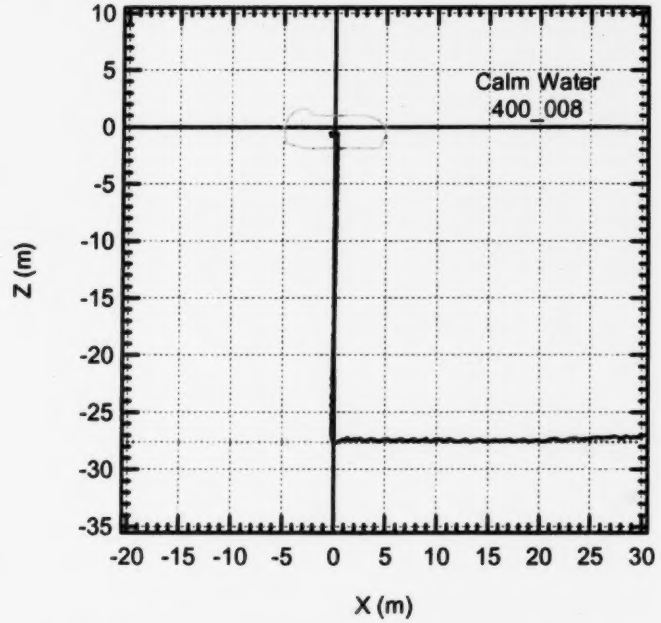

Figure 10.5 – Outboard Profile of the Deployment

During each individual deployment data were recorded as time required to process required activities (i.e. time from launch to splashdown, time from splashdown to davit falls release, time from splashdown to danger zone boundary, time from splashdown to safe zone boundary) and as trajectories taken by the TEMPSC during the deployment, splashdown and sail-away (i.e. path length from splashdown to danger zone boundary, path length from danger to safe zone boundary, distance from target to drop point, setback, deployment excursion). Table 10.6 presents the tabulated data for the entire test series while Figures 10.6 and 10.7 capture the overall effect on the control of the TEMPSC during the evacuation in calm water. In these figures an envelope is drawn that encompasses the path taken by the TEMPSC in all deployment runs. The paths are shown in two views, with the plan view showing sail-away and the outboard profile showing lowering, setback, and sail-away.

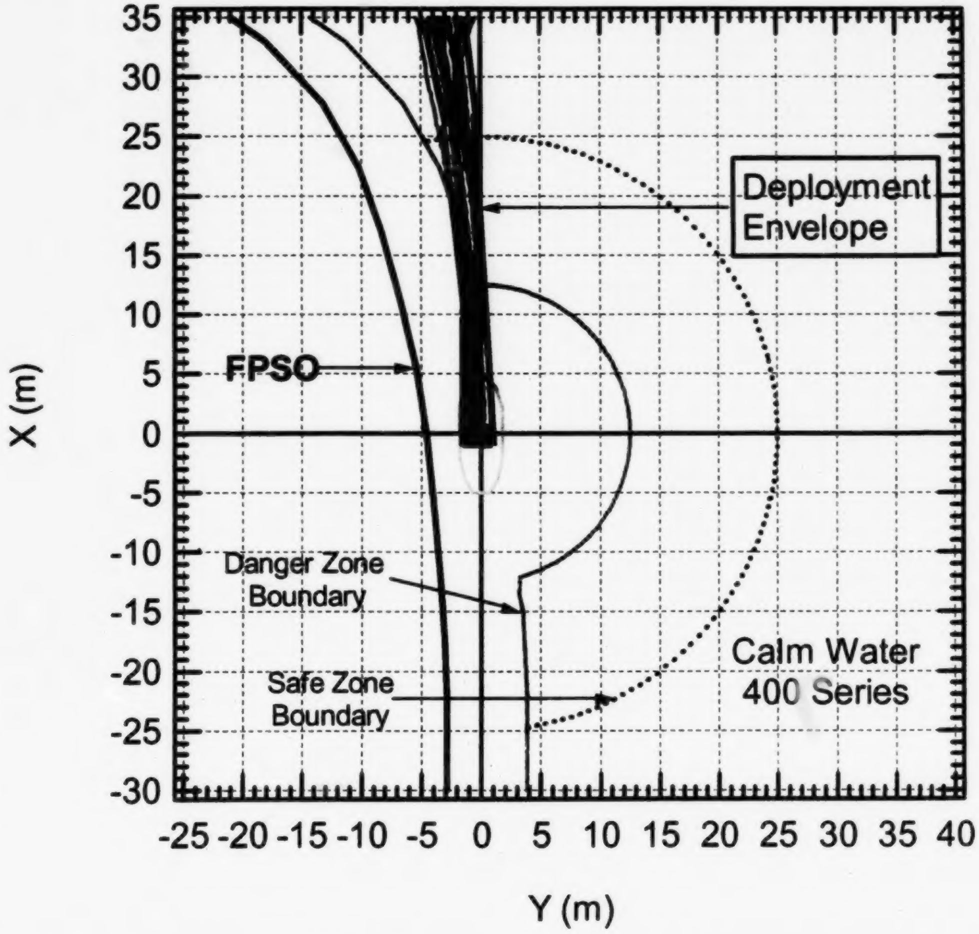

Figure 10.6 – Calm Water, Plan View of Deployment Envelope

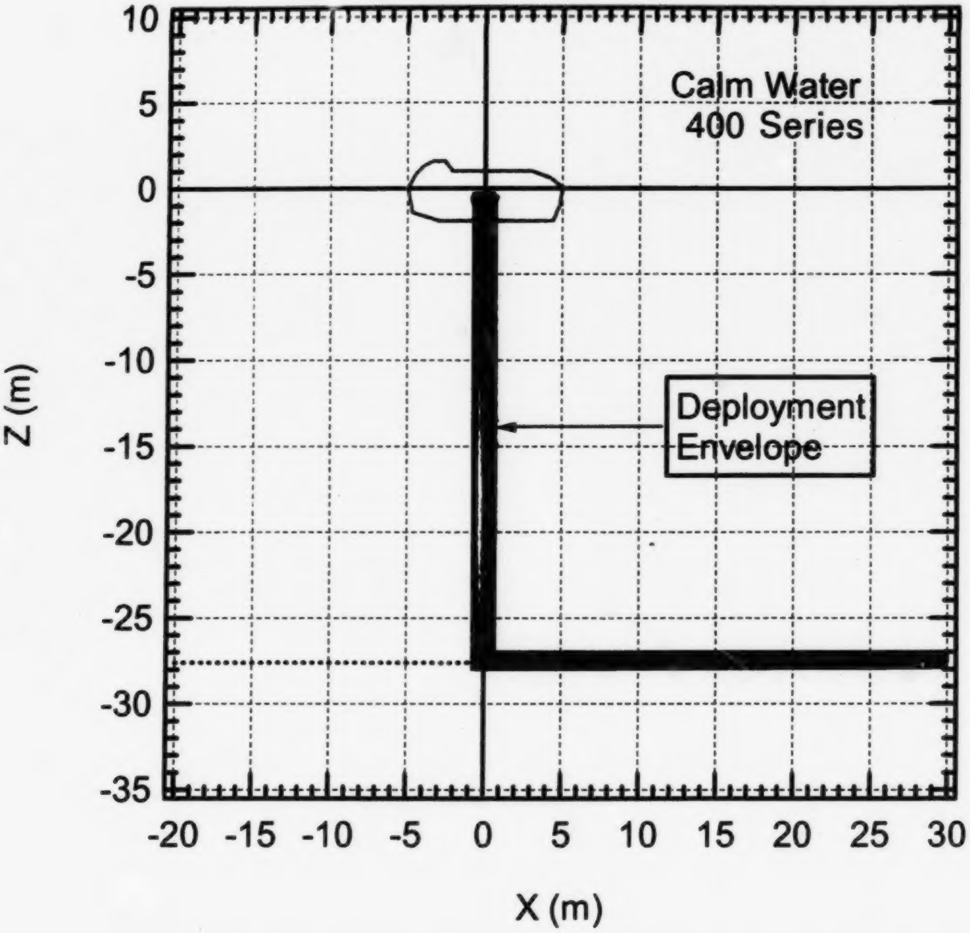

Figure 10.7 – Calm Water, Outboard Profile of Deployment Envelope

Table 10.6 – Summary of Calm Water Deployment Data for Twin Falls Davit System

Run Number	Deployment			Boundary Crossing				Travel Distance		Average Speed			Accelerations		Splashdown		
	Launch to Splash [s]	Splash to Davit [s]	Launch to Davit [s]	Splash to Danger [s]	Splash to Safe [s]	Danger to Safe [s]	Launch to Safe [s]	Splash to Danger [m]	Danger to Safe [m]	Danger Zone [knots]	Inter. zone [knots]	Open sea [knots]	Launch to Splash [g]	Sail away [g]	Missed Target [m]	Setback [m]	Combined miss/set [m]
400_008	27.52	4.18	31.70	9.40	13.08	3.68	40.60	13.00	12.00	2.69	6.34	7.00	0.96	0.29	0.332	0.000	0.332
400_009	27.87	3.93	31.80	9.69	12.32	2.63	40.19	18.75	8.25	3.76	6.10	7.00	0.89	0.25	0.540	0.000	0.540
400_010	28.04	3.86	31.90	9.91	12.33	2.42	40.37	16.00	8.25	3.14	6.63	6.60	0.93	0.23	0.210	0.000	0.210
400_011	29.10	5.20	34.30	8.99	11.93	2.94	41.03	15.00	9.50	3.25	6.27	6.80	0.39	0.58	0.743	0.000	0.743
400_012	28.57	3.33	31.90	8.43	11.05	2.63	39.62	15.00	9.50	3.46	7.02	7.60	0.89	0.43	0.706	0.000	0.706
400_013	28.75	3.45	32.20	10.36	11.94	1.58	40.69	19.25	5.25	3.61	6.47	7.00	0.83	0.81	1.166	0.000	1.166
400_014	27.87	4.33	32.20	9.13	12.60	3.47	40.47	13.25	11.25	2.82	6.30	7.00	1.26	1.30	0.686	0.000	0.686
400_015	29.62	5.68	35.30	7.55	10.92	3.36	40.54	13.50	11.00	3.48	6.35	6.60	0.89	0.21	0.324	0.000	0.324
400_016	27.87	3.13	31.00	10.59	12.80	2.21	40.67	16.00	8.00	2.94	7.04	7.00	0.95	0.21	1.103	0.000	1.103
400_017	27.87	3.83	31.70	10.02	12.64	2.63	40.51	16.00	8.50	3.11	6.29	7.30	1.15	0.97	0.858	0.000	0.858
400_018	28.22	0.38	28.60	8.17	11.96	3.79	40.18	13.00	11.25	3.09	5.78	7.60	0.95	0.33	0.619	0.000	0.619
400_019	28.57	2.33	30.90	9.93	11.93	2.00	40.50	17.50	7.00	3.43	6.81	7.00	0.51	1.68	0.622	0.000	0.622
400_020	27.87	3.83	31.70	8.17	11.43	3.26	39.30	13.00	11.50	3.09	6.86	7.10	0.95	0.32	0.330	0.000	0.330
400_021	29.10	1.30	30.40	7.49	10.22	2.73	39.32	14.50	10.00	3.77	7.11	7.80	0.95	0.51	1.232	0.000	1.232

10.3.2 500 Series – Moderate Breeze
Twin Falls Davit System TEMPSC Deployment

The 500 series – moderate breeze – deployments were performed for the FPSO in the intact condition and for a heading of 20° to the waves and 57° to the wind. A total of 20 deployments were performed. All of the tests were similar and illustrate the lowering, splashdown, and sail-away phases of a test in a moderate breeze. The same three zones described in Section 10.3.1 are used in this series.

For individual deployments data were recorded as time required to process required activities and as trajectories taken by the TEMPSC during the deployment, splashdown and sail-away. The entire test series data are tabulated in Table 10.7 while the overall effect of the environment on the control of the TEMPSC during the evacuation is shown in Figures 10.8 and 10.9. Once again the figures show the envelope that encompasses the path taken by the TEMPSC in each deployment run.

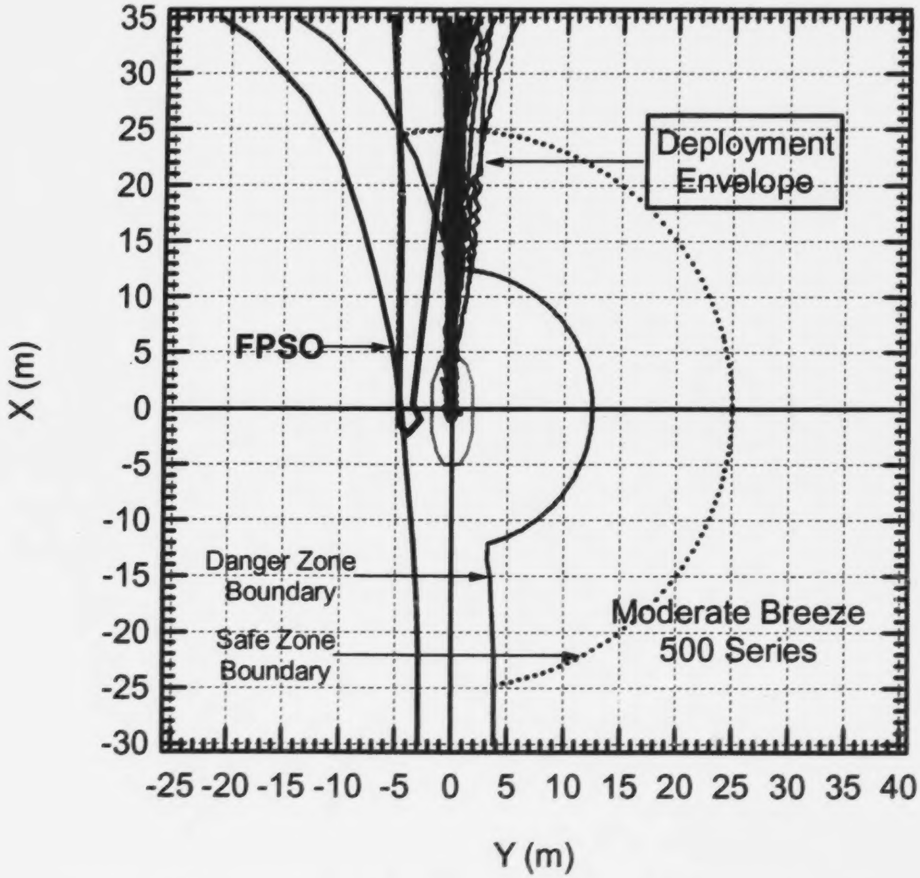

Figure 10.8 – Moderate Breeze, Plan View of Deployment Envelope

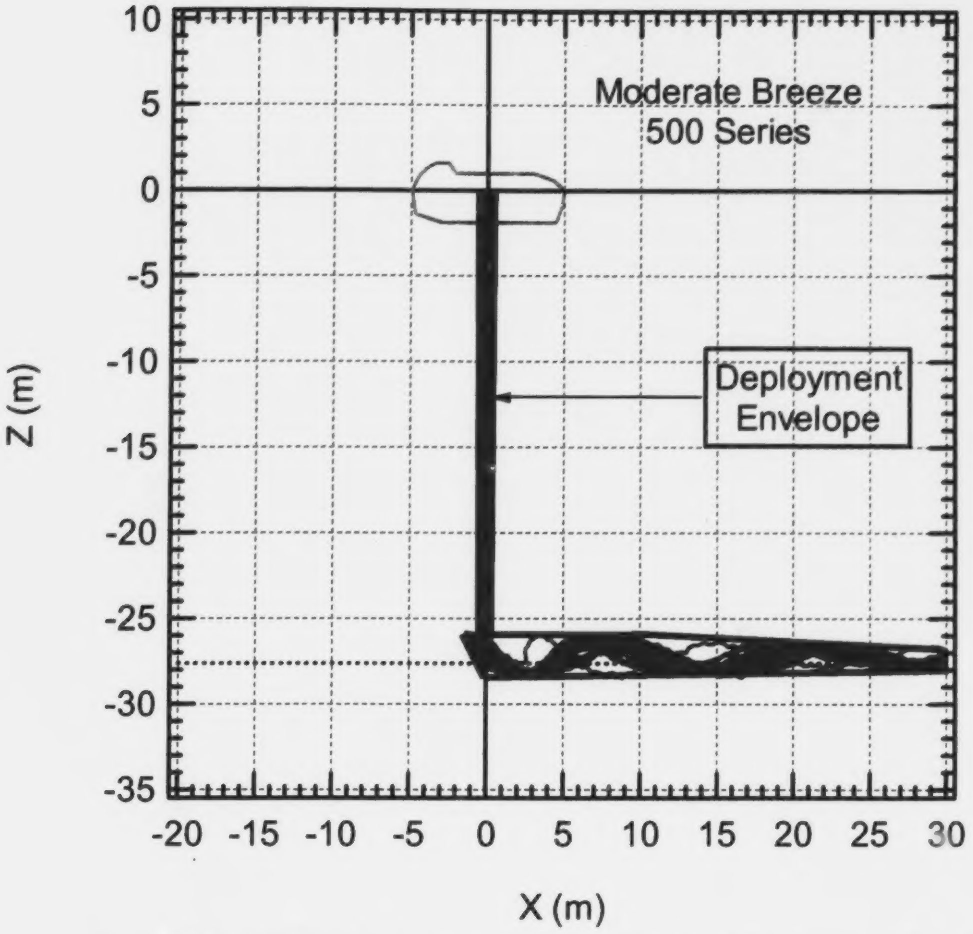

Figure 10.9 – Moderate Breeze, Outboard Profile of Deployment Envelope

When the conditions are not calm, as is the case here, there are additional considerations such as the effects of the vessel motions on the TEMPSC path during lowering and at splashdown. The splashdown point on the wave (i.e. crest, trough, up/down-slope) is important and it is directly connected to the ability of the TEMPSC to make way in the waves. There are instances in which the sail-away ability is hindered by the incoming wave while in others the wave helps the sail-away process.

These are examples of the splashdown point being up-slope, midway between the trough and oncoming crest. In these cases no forward progress was made until the TEMPSC crested the next wave and motored down-slope. In fact, the TEMPSC moved backwards, or was set back, as it motored up-slope the first wave. These types of measurements were recorded for this test series as well as all other series for which waves were present.

Table 10.7 – Summary of Moderate Breeze Deployment Data for Twin Falls Davit System

Run Number	Deployment			Boundary Crossing				Travel Distance		Average Speed			Accelerations		Splashdown			
	Launch to Splah [s]	Splash to Davit [s]	Launch to Davit [s]	Splash to Danger [s]	Splash to Safe [s]	Danger to Safe [s]	Launch to Safe [s]	Splash to Danger [m]	Danger to Safe [m]	Danger Zone [knots]	Inter. Zone [knots]	Open sea [knots]	Launch to Splash [g]	Sail away [g]	On Wave	Missed target [m]	Set-back [m]	Combined miss/set [m]
500_001	28.70	3.00	31.70	7.43	10.90	3.47	39.60	13.00	11.50	3.40	6.44	7.10	0.34	0.24	C	0.371	0.000	0.371
500_002	30.70	4.00	34.70	8.46	11.82	3.37	42.52	12.25	12.00	2.82	6.93	7.70	0.23	0.24	T	0.238	0.455	0.417
500_003	28.70	2.90	31.60	6.35	9.71	3.36	38.41	12.50	12.25	3.83	7.08	7.70	0.22	0.22	C	0.260	0.252	0.370
500_004	27.90	5.70	33.60	9.08	12.86	3.79	40.76	12.50	12.00	2.68	6.16	7.10	0.21	0.22	C	0.560	0.605	0.403
500_005	28.00	6.10	34.10	7.34	11.02	3.68	39.02	12.50	12.25	3.31	6.47	7.10	0.52	0.24	D	0.360	0.000	0.360
500_006	32.10	0.90	33.00	6.66	10.13	3.47	42.23	12.50	12.25	3.65	6.86	7.30	0.64	0.22	D	0.295	0.000	0.295
500_007	31.20	1.60	32.80	7.81	11.38	3.58	42.58	13.00	12.25	3.24	6.66	7.70	0.23	0.20	U	0.820	0.342	1.130
500_008	31.50	0.40	31.90	5.72	9.19	3.47	40.69	13.25	12.25	4.50	6.86	7.60	0.20	0.21	U	0.620	0.000	0.620
500_009	28.70	2.90	31.60	8.37	11.95	3.58	40.65	13.00	12.25	3.02	6.66	7.10	0.19	0.23	U	0.313	0.609	0.723
500_010	29.87	3.93	33.80	6.94	10.41	3.47	40.28	11.75	12.25	3.29	6.86	7.90	0.40	0.20	D	1.228	0.000	1.228
500_011	29.90	1.90	31.80	5.88	9.35	3.47	39.25	12.25	11.50	4.05	6.44	8.00	0.19	0.19	D	1.400	0.000	1.400
500_012	30.00	2.70	32.70	6.42	10.10	3.68	40.10	12.00	12.00	3.63	6.34	7.60	0.19	0.18	D	0.903	0.000	0.903
500_013	31.20	4.70	35.90	6.80	10.16	3.36	41.36	12.50	12.25	3.58	7.08	7.70	0.26	0.18	U	0.305	0.501	0.705
500_014	29.60	2.70	32.30	8.83	12.51	3.68	42.11	12.50	13.25	2.75	7.00	7.40	0.23	0.20	U	0.335	0.859	0.573
500_015	29.60	3.80	33.40	8.22	11.70	3.47	41.30	12.50	12.50	2.95	7.00	7.60	0.26	0.19	U	0.248	0.779	0.611
500_016	29.40	3.30	32.70	9.76	12.50	2.73	41.90	14.50	10.25	2.89	7.29	7.60	0.21	0.23	U	0.272	0.676	0.581
500_017	27.90	3.70	31.60	7.25	10.72	3.47	38.62	12.75	12.00	3.42	6.72	7.10	0.17	0.16	C	0.260	0.000	0.260
500_018	29.74	1.06	30.80	6.10	9.73	3.63	39.47	12.50	12.00	3.98	6.43	7.70	0.20	0.17	C	1.147	0.000	1.147
500_020	29.80	6.60	36.40	8.59	12.27	3.68	42.07	13.00	12.00	2.94	6.34	7.30	0.18	0.16	U	0.329	0.787	0.881
500_021	29.80	3.00	32.80	5.72	9.29	3.58	39.09	12.50	11.00	4.25	5.98	7.60	0.55	0.16	C	1.396	0.000	1.396

C – Crest T – Trough U – Up-slope D – Down-slope

10.3.3 525 Series – Fresh Breeze
Twin Falls Davit System TEMPSC Deployment

The 525 series – fresh breeze – deployments were performed for the FPSO in the intact condition and for a heading of 20° to the waves and 57° to the wind. A total of 19 deployments were performed. The three zones, danger, intermediate and safe, defined in Section 10.3.1 are used throughout these test series. All of the individual experiments were run in a similar manner and illustrate the twin falls davit system in operation in a fresh breeze.

Data were recorded as time necessary to perform activities such as lowering, safe boundary crossing, etc., and as path lengths taken by the TEMPSC after splashdown.

The entire test series data are tabulated in Table 10.8 while the overall effect of the environment on the control of the TEMPSC during the evacuation is shown in Figures 10.10 and 10.11. Once again the figures show the envelope that encompasses the path taken by the TEMPSC in each deployment run.

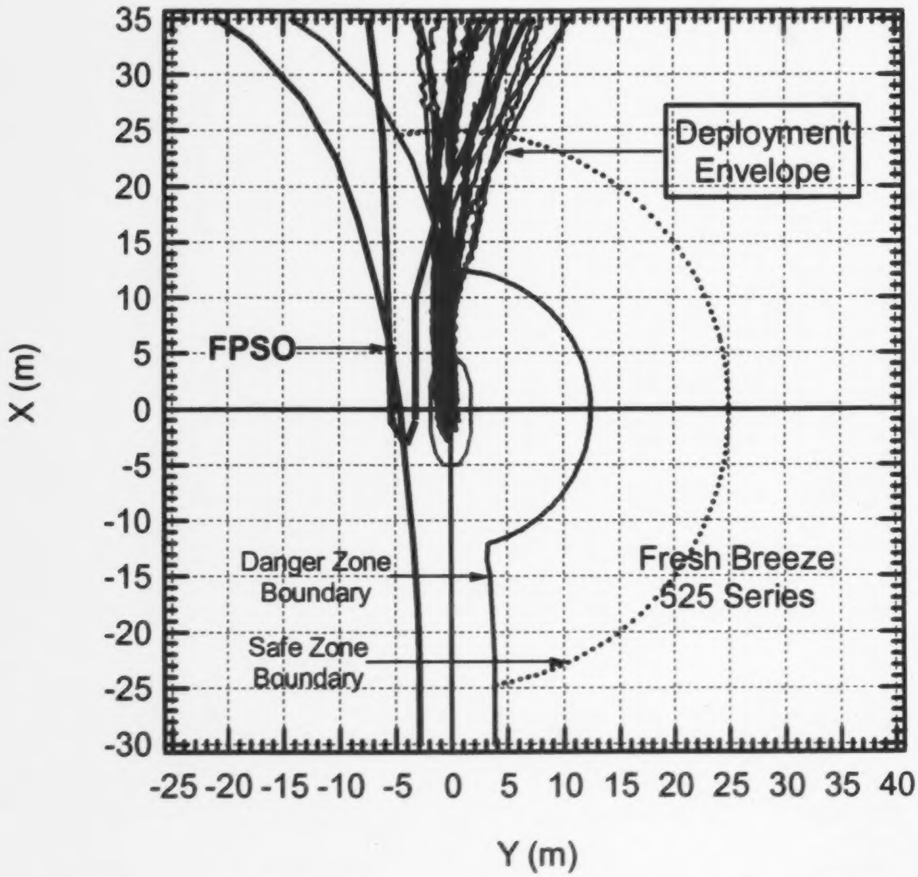

Figure 10.10 – Fresh Breeze, Plan View of Deployment Envelope

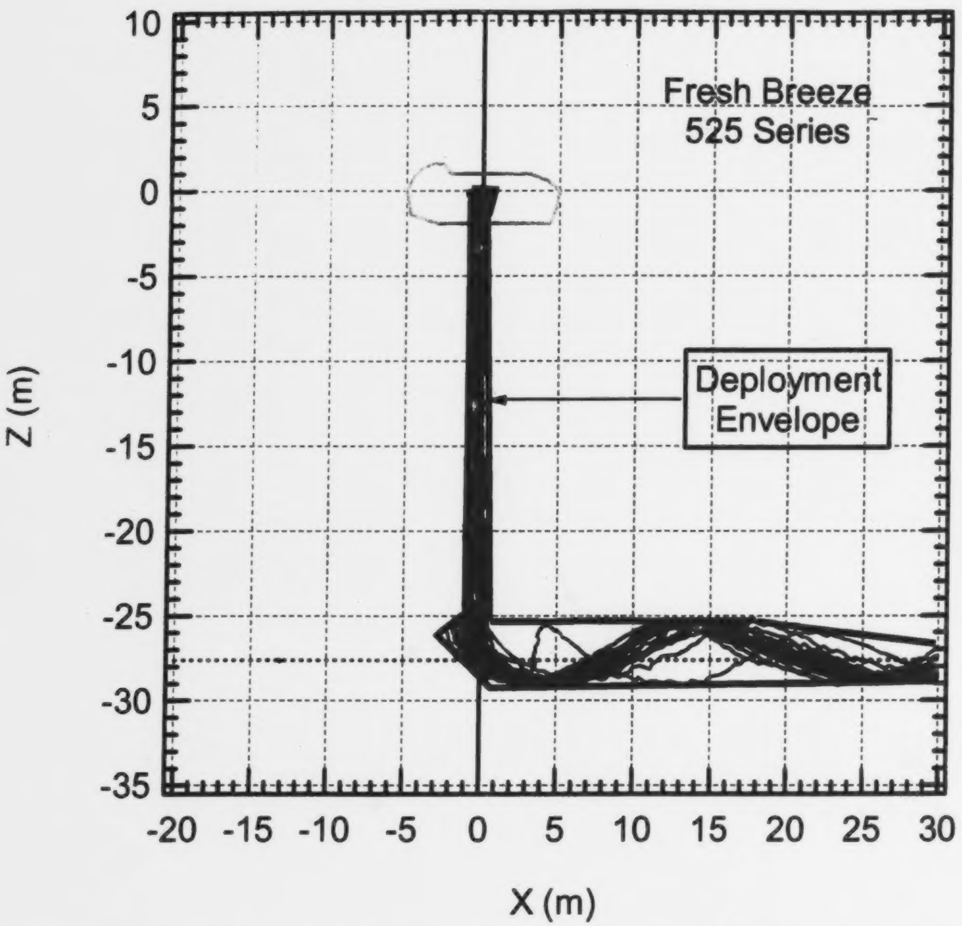

Figure 10.11 – Fresh Breeze, Outboard Profile of Deployment Envelope

In general, platform motions do not appear to be significant in this environmental condition. The individual deployments presented in Appendix 9 show small oscillations during the lowering as the lifeboat swung as a pendulum. Some of this oscillation may be attributable to the direct forcing by the wind, but it is mainly due to the motions set up in the platform by the waves.

Figures 10.10 and 10.11 capture the overall effects of weather conditions on the control of the TEMPSC path during evacuation. The figures show envelopes that encompass the paths taken by the TEMPSC in the test series.

The most obvious trend demonstrated by the figures presented thus far, is that control deteriorates with increase in weather. This can be attributed to the weather alone in the sail-away phase, and to the combined effects of weather and platform motions in the lowering phase.

Table 10.8 – Summary of Fresh Breeze Deployment Data for Twin Falls Davit System

	Deployment			Boundary Crossing				Travel Distance		Average Speed			Accelerations		Splashdown			
Run Number	Launch to Splash [s]	Splash to Davit [s]	Launch to Davit [s]	Splash to Danger [s]	Splash to Safe [s]	Danger to Safe [s]	Launch to Safe [s]	Splash to Danger [m]	Danger to Safe [m]	Danger Zone [knots]	Inter. Zone [knots]	Open sea [knots]	Launch to Splash [g]	Sail away [g]	On Wave	Missed target [m]	Set-back [m]	Combined miss/set [m]
525_001	28.60	3.00	31.60	10.42	12.52	2.10	41.12	19.00	8.25	3.55	7.62	7.70	0.10	0.10	C	0.681	1.390	2.064
525_002	30.50	2.60	33.10	10.57	13.51	2.94	44.01	15.50	11.00	2.85	7.26	7.70	0.12	0.18	U	0.544	1.780	1.662
525_003	28.90	3.90	32.80	10.98	12.87	1.89	41.77	18.00	8.25	3.19	8.47	8.70	0.15	0.13	C	0.497	1.189	0.892
525_005	28.70	4.90	33.60	8.04	11.09	3.05	39.79	16.00	10.75	3.87	6.85	8.50	0.12	0.14	C	0.036	0.526	0.549
525_006	30.50	1.50	32.00	8.60	11.97	3.37	42.47	14.00	12.25	3.16	7.08	9.00	0.12	0.14	U	0.103	1.285	1.323
525_007	31.00	2.00	33.00	8.46	12.14	3.68	43.14	15.50	12.25	3.56	6.47	8.00	0.11	0.15	T	1.544	0.769	1.536
525_008	29.40	1.90	31.30	8.89	12.36	3.47	41.76	15.00	12.50	3.28	7.00	8.70	0.12	0.13	U	0.164	1.511	1.500
525_009	29.30	2.70	32.00	9.22	12.74	3.52	42.04	14.50	12.50	3.06	6.90	8.40	0.12	0.15	U	0.577	1.269	1.622
525_010	27.00	2.30	29.30	11.43	14.90	3.47	41.90	15.75	11.25	2.68	6.30	6.50	0.09	0.12	T	0.644	0.000	0.644
525_013	28.90	1.90	30.80	8.38	11.65	3.26	40.55	14.50	12.50	3.36	7.45	8.70	0.13	0.19	C	0.346	0.991	1.131
525_015	30.10	2.10	32.20	9.05	12.42	3.36	42.52	14.00	12.00	3.01	6.93	8.70	0.09	0.11	U	0.465	1.106	0.792
525_016	28.20	1.50	29.70	8.61	11.45	2.84	39.65	16.25	12.00	3.67	8.21	8.70	0.14	0.13	C	0.334	0.943	1.260
525_017	25.90	2.00	27.90	8.36	10.63	2.26	36.53	17.50	9.25	4.07	7.95	8.60	0.09	0.07	D	0.572	0.000	0.572
525_018	30.00	2.20	32.20	9.23	11.96	2.73	41.96	16.00	10.50	3.37	7.47	8.40	0.07	0.10	D	0.465	1.160	1.310
525_019	29.60	0.40	30.00	9.40	12.45	3.05	42.05	15.50	11.00	3.20	7.01	8.60	0.35	0.35	C	0.121	1.254	1.338
525_020	34.20	-5.40	28.80	5.55	9.23	3.68	43.43	13.50	13.00	4.73	6.87	8.50	0.11	0.11	T	0.706	1.577	1.095
525_021	29.80	1.50	31.30	9.90	13.16	3.26	42.96	19.25	12.50	3.78	7.45	8.10	0.15	0.14	U	0.255	2.253	2.362
525_022	27.70	1.10	28.80	7.02	9.76	2.73	37.46	15.75	9.75	4.36	6.93	8.00	0.13	0.20	C	0.739	0.000	0.739
525_023	28.40	0.30	28.70	6.92	8.92	2.00	37.32	17.00	8.00	4.77	7.78	8.00	0.10	0.12	C	0.204	0.000	0.204

C – Crest T – Trough U – Up-slope D – Down-slope

10.3.4 550 Series –Strong Breeze
Twin Falls Davit System TEMPSC Deployment

The 550 series – strong breeze – deployments were performed for the FPSO in the intact condition and for a heading of 20° to the waves and 57° to the wind. A total of 15 deployments were performed. Data presentation and analysis make use of the three zones identified in Section 10.3.1. All of the individual experiments were run in a similar manner and illustrate the twin falls davit system in operation in a strong breeze.

The data recorded and presented in this report are for the time to lower the TEMPSC to the water surface, the time to move the TEMPSC from splashdown point to safe zone and the path length of the TEMPSC as it moves away to the safe zone from the original splashdown point. The entire test series data are tabulated in Table 10.9 while the overall effect of the environment on the control of the TEMPSC during the evacuation is shown as an envelope encompassing the paths taken by the TEMPSC in each deployment, in Figures 10.12 and 10.13.

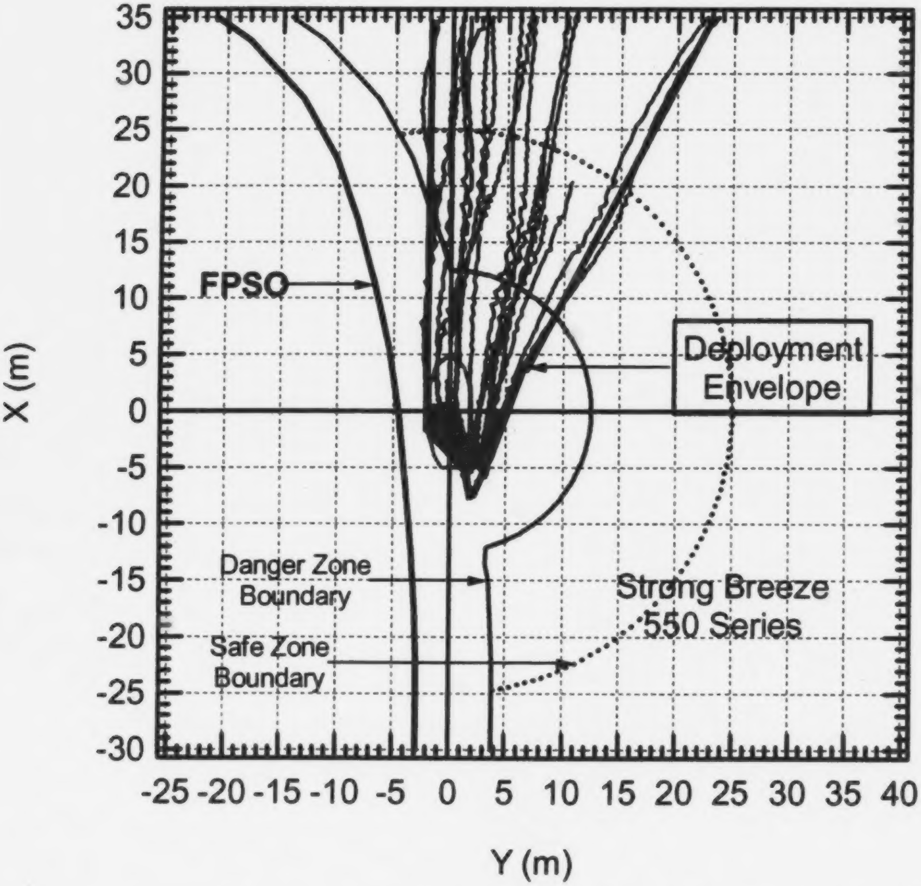

Figure 10.12 – Strong Breeze, Plan View of Deployment Envelope

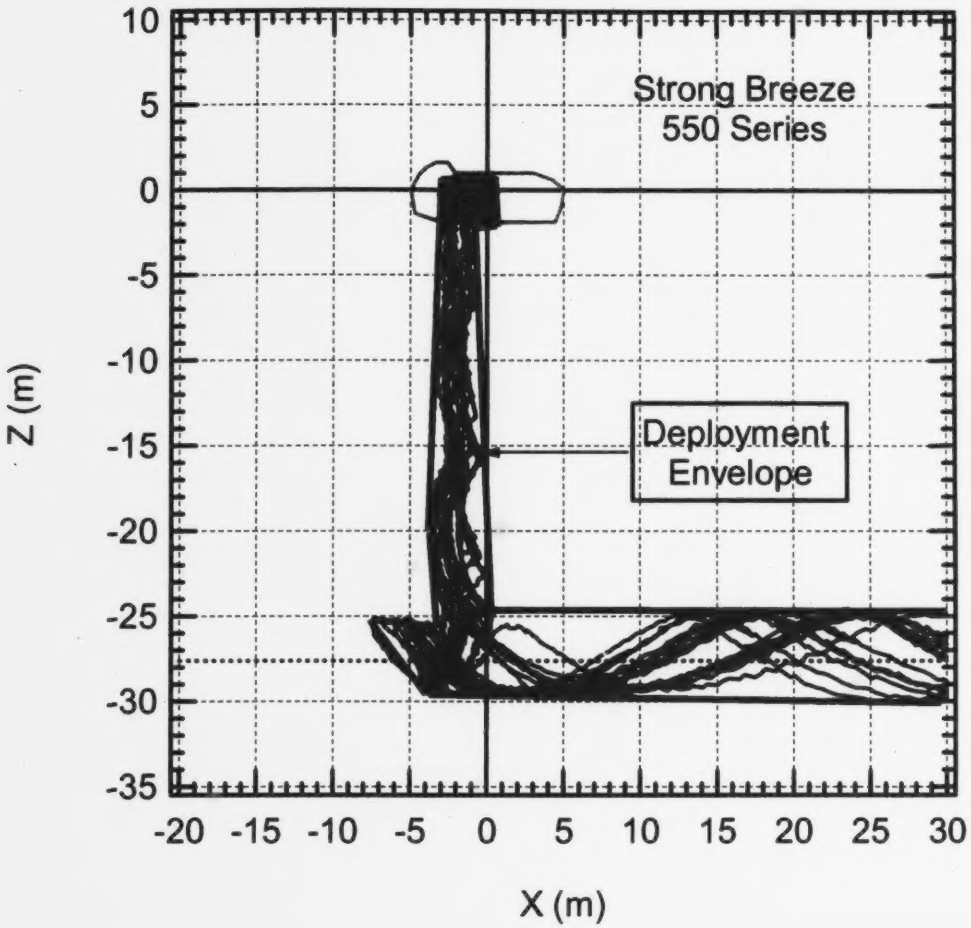

Figure 10.13 – Strong Breeze, Outboard Profile of Deployment Envelope

In general, platform motions start to be significant in this environmental condition. The individual deployments presented in Appendix 9 start to show oscillations in the z-axis of 3-4 m prior to the lowering and oscillations of 3-4 m in the x-axis during the lowering, indicating that the TEMPSC swung as a pendulum. To some degree the oscillations are attributed to the wind force on the TEMPSC, but the majority of the oscillations are due to the motions set up in the platform by the waves.

Figures 10.12 and 10.13 capture the overall effects of weather conditions on the control of the TEMPSC path during evacuation. The figures show envelopes that encompass the paths taken by the TEMPSC in the test series.

To reiterate the statement made in Section 10.3.3, the most noticeable trend demonstrated by the deployment envelope figures is that control deteriorates with increase in weather. In this test series this is attributed to the weather alone in the sail-away phase, and to the combined effects of weather and platform motions in the lowering phase.

Table 10.9 – Summary of Strong Breeze Deployment Data for Twin Falls Davit System

Run Number	Deployment			Boundary Crossing				Travel Distance		Average Speed			Accelerations		Splashdown			
	Launch to Splash [s]	Splash to Davit [s]	Launch to Davit [s]	Splash to Danger [s]	Splash to Safe [s]	Danger to Safe [s]	Launch to Safe [s]	Splash to Danger [m]	Danger to Safe [m]	Danger Zone [knots]	Inter. Zone [knots]	Open sea [knots]	Launch to Splash [g]	Sail away [g]	On Wave	Missed target [m]	Set-back [m]	Combined miss/set [m]
550_001	31.20	1.50	32.70	10.85	15.06	4.21	46.26	20.00	12.50	3.58	5.78	6.20	0.10	0.17	T	1.989	2.920	4.909
550_003	29.80	0.60	30.40	7.98	11.55	3.57	41.35	14.50	12.00	3.53	6.53	6.60	0.11	0.09	U	0.602	0.000	0.602
550_004	26.90	0.00	26.90	15.08	-	-	-	21.25	-	2.74	-	-	0.09	0.07	T	2.945	6.549	3.850
550_005	29.40	0.40	29.80	9.17	12.64	3.47	42.04	14.50	12.25	3.07	6.86	7.30	0.20	0.22	U	0.961	0.000	0.961
550_006	26.30	0.50	26.80	13.50	16.39	2.89	42.69	14.50	12.00	2.09	8.06	8.20	0.20	0.15	T	1.936	1.832	0.918
550_007	26.50	0.30	26.80	17.00	-	-	-	23.75	-	2.72	-	-	0.16	0.29	T	1.979	5.838	3.937
550_008	27.20	0.40	27.60	16.60	20.91	4.31	48.11	25.50	12.50	2.99	5.64	8.20	0.17	0.19	T	2.388	7.309	5.552
550_010	27.70	5.20	32.90	15.00	19.32	4.31	47.02	22.75	12.50	2.95	5.64	6.60	0.14	0.13	T	1.802	5.581	3.793
550_011	26.80	1.60	28.40	7.71	10.45	2.74	37.25	18.00	8.00	4.54	5.69	7.00	0.14	0.14	C	0.697	0.000	0.697
550_012	29.80	2.60	32.40	11.89	16.10	4.21	45.90	19.00	12.75	3.11	5.89	6.40	0.14	0.13	T	0.354	2.855	3.203
550_016	29.10	1.10	30.20	12.61	17.02	4.42	46.12	19.50	13.00	3.01	5.72	6.40	0.13	0.17	U	0.546	2.861	3.112
550_018	28.70	0.70	29.40	10.94	14.20	3.26	42.90	16.00	12.50	2.84	7.45	7.70	0.14	0.14	U	0.872	0.850	1.483
550_019	26.60	2.40	29.00	6.67	9.30	2.63	35.90	17.25	8.50	5.03	6.29	6.60	0.14	0.14	C	2.095	0.000	2.095
550_020	29.60	2.80	32.40	12.53	16.64	4.10	46.24	18.50	11.50	2.87	5.45	5.80	0.10	0.10	T	0.379	3.593	3.568
550_021	26.50	3.40	29.90	7.50	12.02	4.52	38.52	14.00	12.50	3.63	5.37	6.90	0.13	0.13	C	0.805	0.000	0.805
550_022	28.20	4.00	32.20	13.31	17.27	3.96	45.47	22.50	12.25	3.29	6.01	6.00	0.11	0.30	T	1.579	5.313	4.724
550_023	27.20	0.20	27.40	5.30	8.66	3.37	35.87	15.00	10.50	5.50	6.06	6.20	0.12	0.11	C	2.531	0.000	2.531

C – Crest T – Trough U – Up-slope D – Down-slope

10.3.5 600 Series – Moderate Gale
Twin Falls Davit System TEMPSC Deployment

The 600 series – moderate gale – deployments were performed for the FPSO in the intact condition and for a heading of 20° to the waves and 57° to the wind. A total of 14 deployments were performed. All of the individual experiments were run in a similar manner and illustrate the twin falls davit system in operation in a moderate gale. The data presented herein are for the time to lower the TEMPSC to the water surface, the time to move the TEMPSC from splashdown point to safe zone and the path length of the TEMPSC as it moves away towards the safe boundary zone from the original splashdown point. The 600 series data are tabulated in Table 10.10. The overall effect of the environment on the control of the TEMPSC during the evacuation is shown in Figures 10.14 and 10.15 as an envelope encompassing the paths taken by the TEMPSC in each deployment. The individual runs data for FPSO motions, TEMPSC location, wind and waves together with the detailed video analysis are presented in Appendix 9.

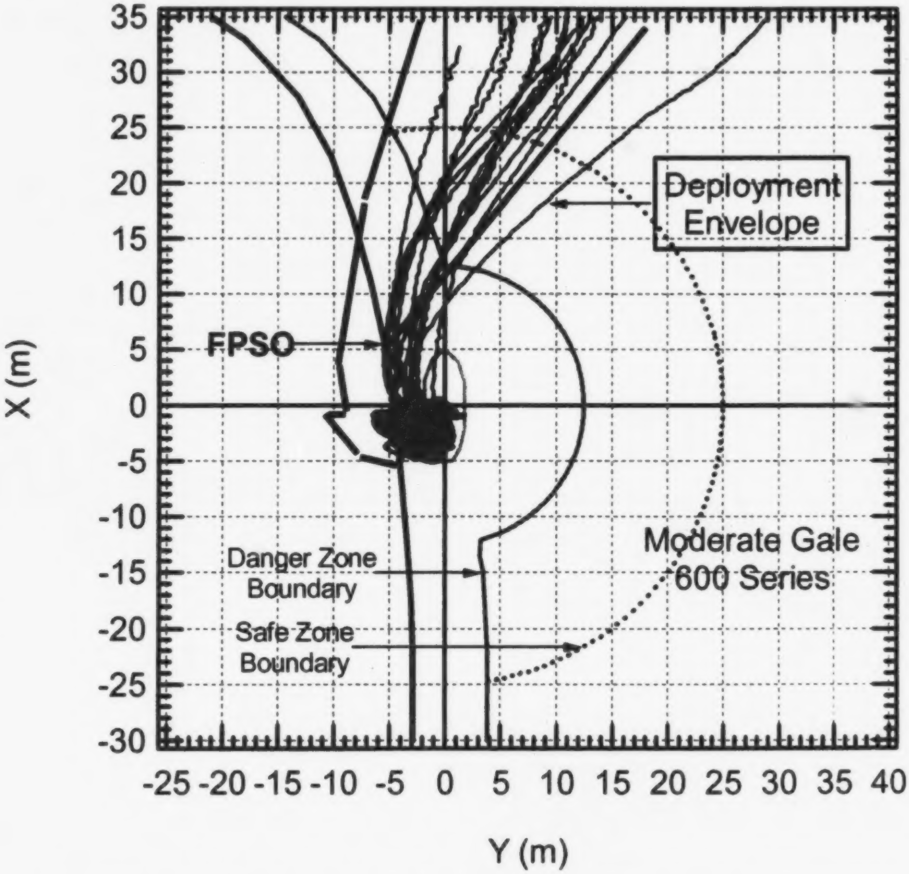

Figure 10.14 – Moderate Gale, Plan View of Deployment Envelope

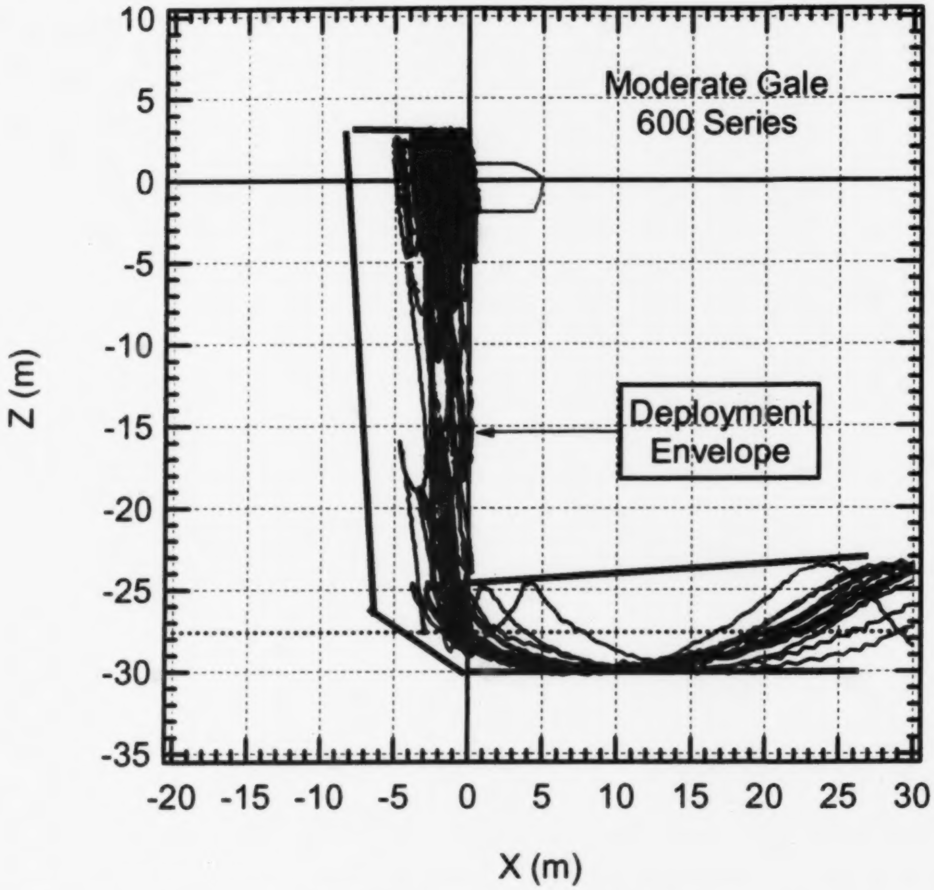

Figure 10.15 – Moderate Gale, Outboard Profile of Deployment Envelope

In general, platform motions are significant in this environmental condition. The individual deployments presented in Appendix 9 start to show oscillations in the z-axis in the range of 8 m prior to the lowering and oscillatory pendulum-like motions of about 5 m amplitude in the x-axis during the lowering. The oscillatory motions are largely induced by the platform with the wind force contributing to a much smaller extent. Figures 10.14 and 10.15 show envelopes that encompass all the paths taken by the TEMPSC during the lowering and sail-away phases and capture the overall effects of weather conditions on the control of the TEMPSC path during evacuation.

The envelopes' shape and size give a good indication of the degradation of the TEMPSC deployment system with an increase in environmental conditions and the reduction in TEMPSC control during sail-away.

Table 10.10 – Summary of Moderate Gale Deployment Data for Twin Falls Davit System

Run Number	Deployment			Boundary Crossing				Travel Distance		Average Speed			Accelerations		Splashdown			
	Launch to Splash [s]	Splash to Davit [s]	Launch to Davit [s]	Splash to Danger [s]	Splash to Safe [s]	Danger to Safe [s]	Launch to Safe [s]	Splash to Danger [m]	Danger to Safe [m]	Danger Zone [knots]	Inter. Zone [knots]	Open Sea [knots]	Launch to Splash [g]	Sail away [g]	On Wave	Missed target [m]	Set-back [m]	Combined miss/set [m]
600_002	27.50	1.70	29.20	9.58	10.42	0.84	37.92	22.50	4.00	4.57	9.24	9.60	0.14	0.13	U	1.985	0.000	1.985
600_003	24.40	5.10	29.50	11.27	13.82	2.55	38.22	16.25	12.00	2.80	9.13	9.20	0.10	0.12	U	2.360	3.055	1.501
600_005	27.40	2.20	29.60	9.03	11.35	2.31	38.75	17.25	12.50	3.71	10.51	11.70	0.13	0.12	U	2.264	0.000	2.264
600_006	24.90	0.20	25.10	11.15	12.83	1.68	37.73	20.25	9.00	3.53	10.40	10.60	0.83	0.17	U	0.635	0.000	0.635
600_007	25.80	1.80	27.60	10.76	12.45	1.68	38.25	20.75	8.50	3.75	9.82	11.40	0.77	0.10	U	2.260	2.397	0.498
600_008	23.10	2.00	25.10	12.68	15.10	2.42	38.20	18.00	12.00	2.76	9.64	10.10	0.27	0.70	U	0.933	3.532	2.612
600_009	26.50	3.60	30.10	12.18	-	-	-	29.25	1.61	4.67	-	11.10	0.92	0.14	T	4.766	0.000	4.766
600_011	24.90	1.30	26.20	11.43	13.43	2.00	38.33	22.50	9.50	3.83	9.24	9.70	1.25	0.62	U	1.282	2.148	1.178
600_016	25.40	1.00	26.40	10.31	12.83	2.52	38.23	21.00	12.50	3.96	9.65	11.80	0.84	0.87	U	1.257	1.921	1.096
600_017	27.20	2.90	30.10	10.04	11.73	1.68	38.93	21.00	9.00	4.06	10.40	11.20	0.25	0.14	U	1.634	0.000	1.634
600_018	25.40	0.90	26.30	10.68	12.57	1.89	37.97	21.00	10.00	3.82	10.27	10.60	0.75	0.80	U	3.034	0.000	3.034
600_020	22.10	1.50	23.60	13.76	16.39	2.63	38.49	17.25	12.50	2.44	9.24	9.20	0.09	1.11	U	0.921	3.012	3.696
600_021	25.40	1.90	27.30	10.48	12.90	2.42	38.30	17.50	12.00	3.25	9.64	7.80	0.77	0.09	U	0.721	3.097	2.392
600_022	25.10	0.00	25.10	11.18	13.92	2.74	39.02	21.00	13.50	3.65	9.60	7.60	0.76	0.77	U	2.711	3.430	1.904

C – Crest T – Trough U – Up-slope D – Down-slope

10.3.6 625 Series – Fresh Gale Twin Falls Davit System TEMPSC Deployment

The 620 series – fresh gale – deployments were performed for the FPSO in the intact condition and for a heading of 20° to the waves and 57° to the wind. A total of 14 deployments were performed. The individual experiments were run following the same procedure and illustrate the twin falls davit evacuation system operation in a fresh gale. The data are for the lowering of the TEMPSC to the water surface and the sail-away to the safe boundary zone. The data collected are for both time to execute the process and the path length taken.

The fresh gale data are tabulated in Table 10.11 with the overall effect of the environment on the control of the TEMPSC during the evacuation shown in Figures 10.16 and 10.17. These are presented as envelopes encompassing the paths taken by the TEMPSC in each deployment from the lowering to the crossing of the safe boundary zone and beyond. The data for FPSO motions, TEMPSC location, wind and waves together with the detailed video analysis are presented in Appendix 9 for the individual test runs.

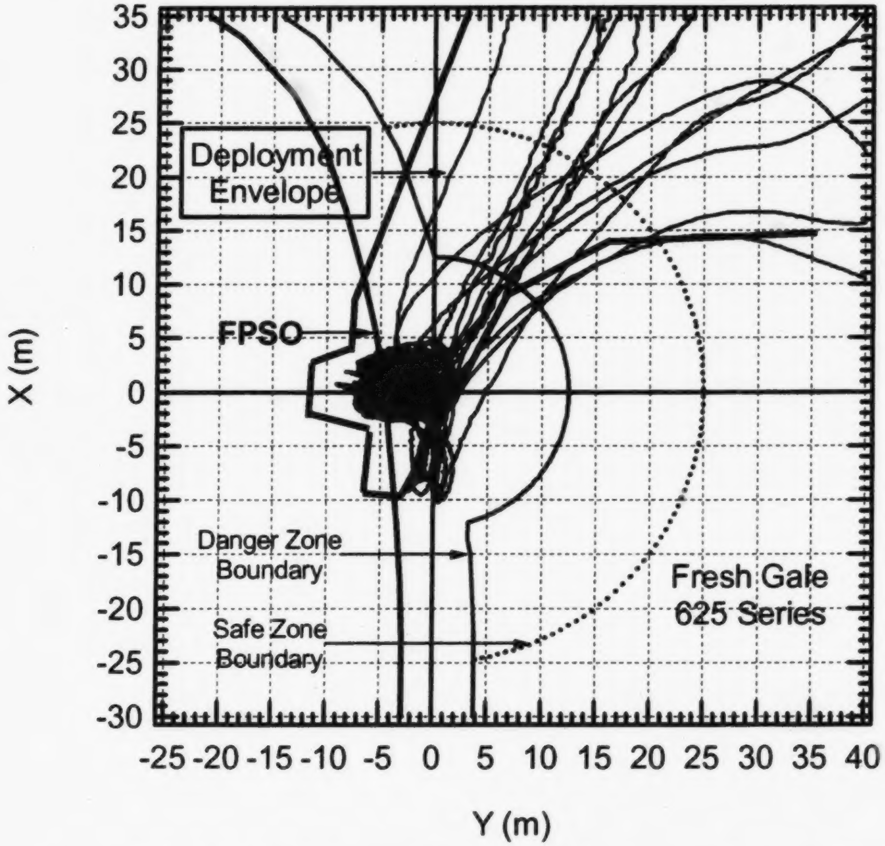

Figure 10.16 – Fresh Gale, Plan View of Deployment Envelope

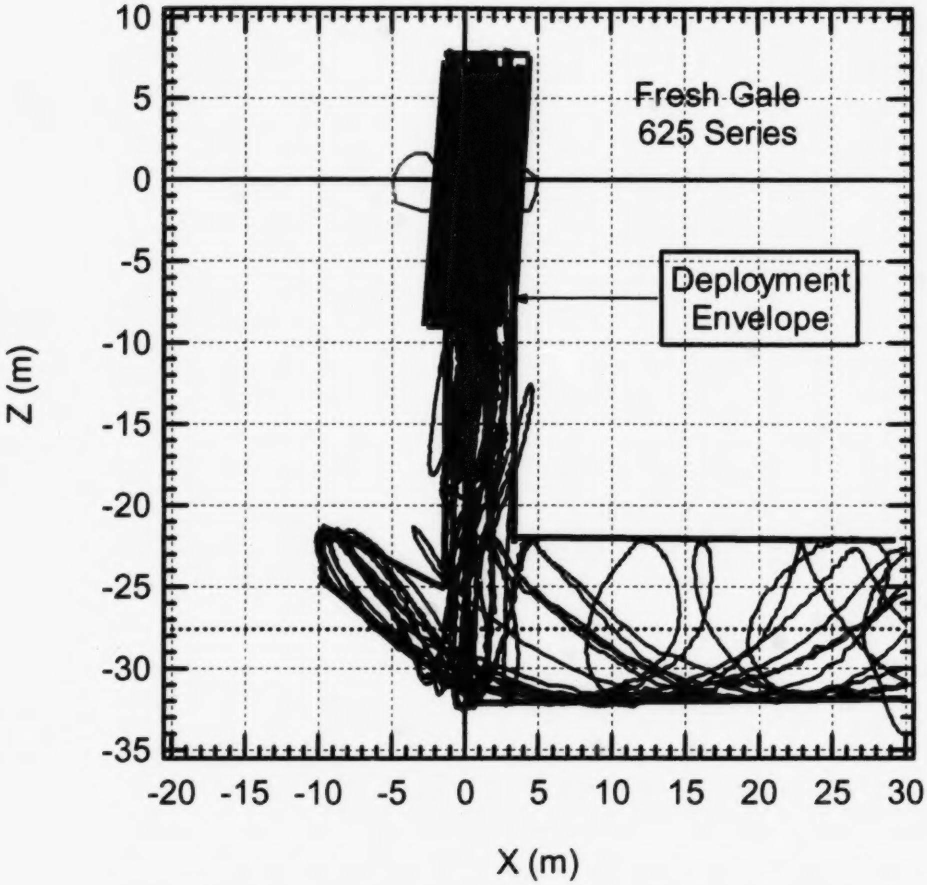

Figure 10.17 – Fresh Gale, Outboard Profile of Deployment Envelope

Platform motions are severe in this environmental condition. The individual deployments presented in Appendix 9 show oscillations in the z-axis in the range of ±8 m prior to the lowering and oscillatory pendulum-like motions of about 6 m or more amplitude in the x-axis during the lowering. The oscillatory motions are induced by the FPSO with the wind force having a minor contribution. The envelopes that encompass all the paths taken by the TEMPSC during the lowering and sailing away phases are presented in Figures 10.16 and 10.17. These figures capture the overall effects of weather on the control path of the TEMPSC during evacuation. The envelopes' irregular shape and size increase over the last weather series give a good indication of the rapid degradation of the TEMPSC deployment system with an increase in environmental conditions and the reduction in TEMPSC control during sail-away.

Table 10.11 – Summary of Fresh Gale Deployment Data for Twin Falls Davit System

Run Number	Deployment			Boundary Crossing				Travel Distance		Average Speed			Accelerations		Splashdown			
	Launch to Splash [s]	Splash to Davit [s]	Launch to Davit [s]	Splash to Danger [s]	Splash to Safe [s]	Danger to Safe [s]	Launch to Safe [s]	Splash to Danger [m]	Danger to Safe [m]	Danger Zone [knots]	Inter. Zone [knots]	Open Sea [knots]	Launch to Splash [g]	Sail away [g]	On Wave	Missed target [m]	Set-back [m]	Combined miss/set [m]
625_001	26.60	1.60	28.20	6.14	8.34	2.21	34.95	20.75	12.50	6.57	11.00	11.60	0.91	1.35	T	10.456	0.000	10.456
625_004	21.00	5.40	26.40	11.35	13.56	2.21	34.56	29.50	12.50	5.05	11.01	8.50	0.32	0.26	U	6.596	6.472	11.404
625_005	24.40	2.30	26.70	6.32	8.74	2.42	33.14	21.75	15.00	6.69	12.05	10.20	1.25	0.06	T	3.448	1.423	2.392
625_006	21.90	3.00	24.90	10.66	13.08	2.42	34.98	28.00	13.00	5.11	10.45	9.60	0.51	1.30	U	7.960	13.480	10.068
625_007	25.20	0.00	25.20	23.67	33.34	9.67	58.54	44.50	19.00	3.65	3.82	4.80	0.75	0.72	T	8.963	0.000	8.963
625_008	28.90	0.10	29.00	14.23	16.33	2.10	45.23	19.50	12.50	2.66	11.55	12.30	0.17	1.48	T	2.601	0.000	2.601
625_009	24.50	5.60	30.10	8.22	10.43	2.21	34.93	25.00	12.50	5.91	11.00	9.50	0.10	0.09	T	9.265	14.062	8.644
625_011	23.10	0.90	24.00	10.13	12.34	2.21	35.44	27.50	13.00	5.28	11.45	11.00	0.04	1.45	U	6.881	6.212	11.379
625_012	21.20	3.90	25.10	11.28	13.38	2.10	34.58	29.00	12.50	5.00	11.55	7.80	0.04	1.02	U	8.175	7.886	14.687
625_013	29.10	0.70	29.80	13.40	15.71	2.31	44.81	20.50	12.50	2.97	10.51	12.70	1.17	0.12	T	2.144	0.000	2.144
625_014	23.70	1.70	25.40	8.95	11.05	2.10	34.75	24.50	12.50	5.32	11.55	13.00	0.04	0.11	T	8.853	3.556	11.074
625_017	21.20	4.10	25.30	10.00	12.00	2.00	33.20	20.00	12.50	3.89	12.16	13.10	0.02	0.05	T	3.015	4.465	6.307
625_018	25.40	1.00	26.40	6.52	8.20	1.68	33.60	16.50	10.25	4.92	11.85	13.10	0.02	0.07	T	1.682	0.744	1.307
625_019	28.90	0.20	29.10	13.84	16.25	2.41	45.15	13.00	13.00	1.83	10.47	11.40	0.68	0.98	T	2.055	0.867	2.865

C – Crest T – Trough U – Up-slope D – Down-slope

10.4 TEMPSC Deployment from FPSO – Flexible Boom System (Series 700, 725, 800)

TEMPSC deployment from the FPSO with the flexible boom evacuation system can be described as a subset, or secondary objective of the test program. Data collected for the FPSO, TEMPSC, evacuation system and environment conditions were used to evaluate the overall performance of the flexible boom system. The different series refer to TEMPSC deployments in:

700 series – Calm Water, 20 runs

725 series – Fresh Breeze, 19 runs

800 series – Fresh Gale, 19 runs

The test program for the TEMPSC flexible boom deployment system has a total of 58 runs analyzed of a projected total of 60. The 2 runs that were not analyzed represent runs for which data quality was poor mechanical failures due to low battery power occurred.

The data for FPSO motions, TEMPSC location, wind and waves together with the detailed video analysis are presented in Appendix 9 for the individual test runs.

10.4.1 700 Series – Calm Water Flexible Boom TEMPSC Deployment

The 700 series – calm water – deployments were performed for the FPSO in the intact condition and for the heading of 20° to the waves and 57° to the wind. A total of 20 deployments were performed. Instructions were relayed to the operator for minimal use of rudder during the initial sail-away. Compliance with this requirement insured that data for the flexible boom relating to time, path length and trajectory could be compared to the data collected for the twin falls davit system. As in the previous set of experiments no rudder angle data are available. The radio controller was calibrated such that different notches on the controller corresponded to different rudder angles. This allowed the operator to consistently provide relatively similar rudder input.

The individual experiments were run following the same procedure and illustrate the flexible boom evacuation system operation in calm water. The evacuation system and TEMPSC data are for lowering and sail-away. A plan view outlining the TEMPSC in its deployed position prior to lowering, together with the waterline of the FPSO hull and three demarked regions, (danger, intermediate and safe) are used to identify the trajectory of the TEMPSC and its path length. The figure is also used to obtain time-related data for the TEMPSC crossing the different regions. An outboard profile view of the deployment is used to look at the TEMPSC oscillations during lowering and setback at splashdown.

The deployment data are summarized and tabulated in Table 10.12 with the path of the TEMPSC illustrated in Figures 10.18 and 10.19.

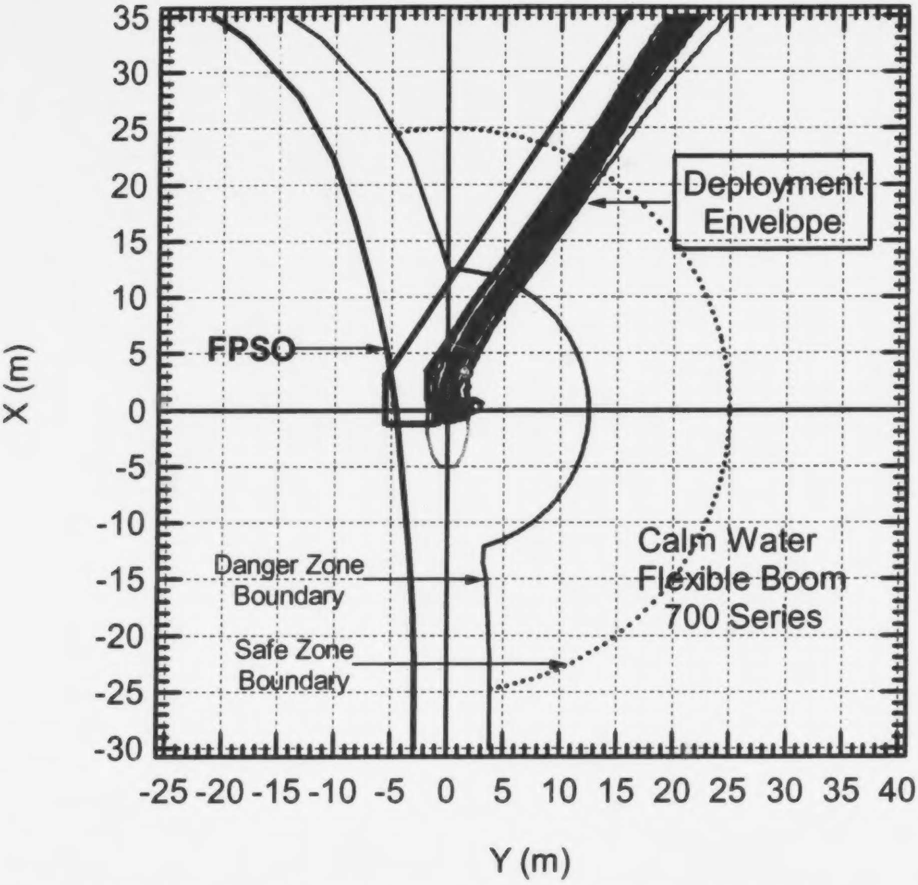

Figure 10.18 – Calm Water, Plan View of Deployment Envelope Flexible Boom System

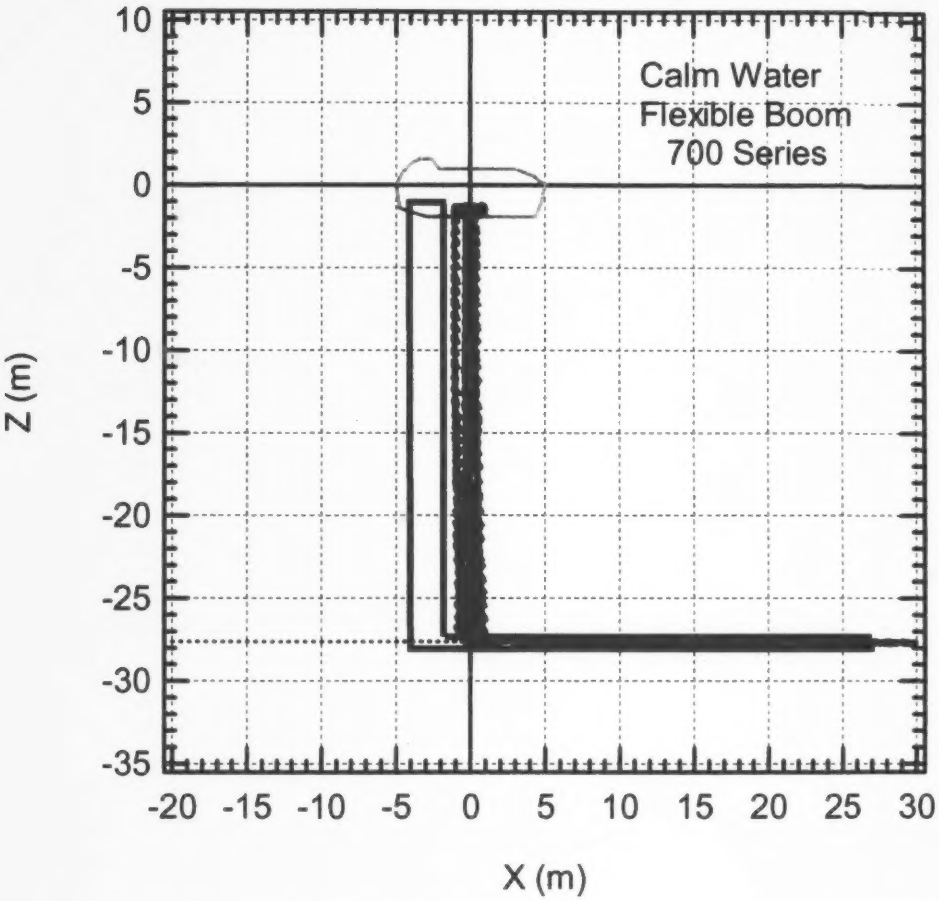

Figure 10.19 – Calm Water, Outboard Profile of Deployment Envelope
Flexible Boom System

During calm water deployments with the flexible boom system the path of the TEMPSC is simple: it goes straight down during lowering, as indicated in Figure 10.19; upon splashdown into the danger zone it sails at an angle of approximately 45° through the intermediate zone to safety, as illustrated in the Figure 10.18.

Table 10.12 – Summary of Calm Water Deployment Data for Flexible Boom System

Run Number	Deployment						Boundary Crossing				Travel Distance		Average Speed			Accelerations		Splashdown		
	Launch to Splash [s]	Splash to Davit [s]	Splash to Tagline [s]	Davit to Tagline [s]	Launch to Davit [s]	Launch to Tagline [s]	Splash to Danger [s]	Splash to Safe [s]	Danger to Safe [s]	Launch to Safe [s]	Splash to Danger [m]	Danger to Safe [m]	Danger Zone [knots]	Inter. Zone [knots]	Open Sea [knots]	Launch to Splash [g]	Sail away [g]	Missed target [m]	Set-back [m]	Combined miss/set [m]
700_001	29.62	0.02	8.52	8.50	29.64	38.14	5.44	9.02	3.58	38.64	13.00	12.50	4.64	6.80	7.60	0.03	0.15	0.643	0.000	0.643
700_002	28.92	0.38	9.18	8.80	29.30	38.10	6.08	9.76	3.68	38.68	13.00	12.50	4.16	6.60	7.40	0.03	0.15	0.869	0.000	0.869
700_003	28.22	1.58	9.58	8.00	29.80	37.80	7.38	10.96	3.58	39.18	12.75	12.50	3.36	6.80	7.30	0.03	0.22	0.979	0.000	0.979
700_005	28.40	1.00	9.40	8.40	29.40	37.80	7.09	10.67	3.58	39.07	12.50	12.50	3.43	6.80	7.40	0.04	0.46	1.114	0.000	1.114
700_006	27.87	1.93	10.33	8.40	29.80	38.20	7.74	11.42	3.68	39.29	13.00	12.50	3.27	6.60	8.10	0.05	0.47	0.217	0.000	0.217
700_007	27.87	2.13	10.23	8.10	30.00	38.10	6.86	10.47	3.61	38.34	13.00	12.50	3.68	6.74	7.90	0.04	0.16	0.410	0.000	0.410
700_008	28.40	2.11	9.91	7.80	30.51	38.31	6.63	10.20	3.58	38.60	12.75	12.50	3.74	6.80	7.40	0.17	0.35	0.562	0.000	0.562
700_009	29.10	1.00	9.30	8.30	30.10	38.40	6.01	9.58	3.58	38.68	13.00	12.50	4.21	6.80	7.90	0.05	0.51	1.518	0.000	1.518
700_010	28.40	0.81	10.00	9.19	29.21	38.40	7.13	10.81	3.68	39.21	13.00	12.50	3.54	6.60	7.40	0.04	0.46	0.228	0.000	0.228
700_011	27.69	2.47	11.07	8.60	30.16	38.76	7.27	10.74	3.47	38.43	12.50	12.50	3.34	7.00	8.10	0.03	0.27	0.199	0.000	0.199
700_012	27.69	3.21	10.21	7.00	30.90	37.90	7.17	10.64	3.47	38.33	13.00	12.50	3.53	7.00	7.90	0.02	0.19	0.608	0.000	0.608
700_013	28.22	2.28	10.48	8.20	30.50	38.70	6.52	10.10	3.58	38.32	13.00	12.50	3.87	6.80	7.40	0.03	0.16	0.698	0.000	0.698
700_014	28.40	1.20	8.90	7.70	29.60	37.30	6.37	9.84	3.47	38.24	12.50	12.50	3.82	7.00	7.90	0.03	0.11	1.147	0.000	1.147
700_015	27.87	1.73	9.23	7.50	29.60	37.10	6.86	10.33	3.47	38.20	12.50	12.50	3.54	7.00	7.90	0.02	0.07	0.952	0.000	0.952
700_016	28.40	1.70	9.50	7.80	30.10	37.90	7.12	10.59	3.47	38.99	12.50	12.50	3.41	7.00	8.10	0.02	0.51	0.192	0.000	0.192
700_017	25.42	4.08	12.38	8.30	29.50	37.80	9.57	13.04	3.47	38.46	14.00	12.50	2.84	7.00	7.90	0.02	0.38	0.312	0.000	0.312
700_018	27.34	1.64	11.44	9.80	28.98	38.78	7.01	10.48	3.47	37.82	13.75	12.50	3.81	7.00	7.90	0.03	0.30	0.367	0.000	0.367
700_019	28.92	-0.40	8.70	9.10	28.52	37.62	5.97	9.44	3.47	38.36	13.00	12.50	4.23	7.00	7.70	0.01	0.39	0.537	0.000	0.537
700_020	28.04	1.26	10.46	9.20	29.30	38.50	6.62	10.09	3.47	38.13	13.50	12.50	3.96	7.00	7.90	0.02	0.38	0.200	0.000	0.200
700_021	27.87	2.01	9.81	7.80	29.88	37.68	7.35	10.82	3.47	38.69	14.00	12.50	3.70	7.00	7.90	0.02	0.51	1.024	0.000	1.024

10.4.2 725 Series – Fresh Breeze Flexible Boom TEMPSC Deployment

The 725 series – fresh breeze – deployments for the flexible boom system were performed for the FPSO in the intact condition and with a heading of 20° to the waves and 57° to the wind. A total of 19 deployments were performed. The data are presented in plan and.outboard profile views. In the plan view the outline of the TEMPSC is shown in its deployed position prior to lowering, which is used as a reference position. A pair of axes is centred at its midpoint. The waterline of the FPSO hull is also shown. Outboard of the FPSO the water surface is divided into three regions: a danger zone, an intermediate zone, and a safe zone. The danger zone is the area bounded by a 12.5 m radius from the TEMPSC's reference position and extending 6.6 m outboard from the FPSO's waterline. The region outside a 25 m radius is the safe zone, and the circular band between the danger and safe zones is the intermediate zone. In the outboard profile view the lowering, splashdown and sail-away of the TEMPS C is illustrated. All of the individual experiments were run in a similar manner and illustrate the operation of the flexible boom system in a fresh breeze.

The data presented herein are for the time to lower the TEMPSC to the water surface, the time to move the TEMPSC from splashdown point to safe zone and the path length of the TEMPSC as it moves away towards the safe boundary zone from the original splashdown point. The 725 series data are tabulated in Table 10.11. The overall effect of the environment on the control of the TEMPSC during the evacuation is shown in Figures 10.20 and 10.21 as envelopes encompassing the paths taken by the TEMPSC in each deployment. The two figures capture the overall effects of weather conditions on the control of the TEMPSC path during evacuation.

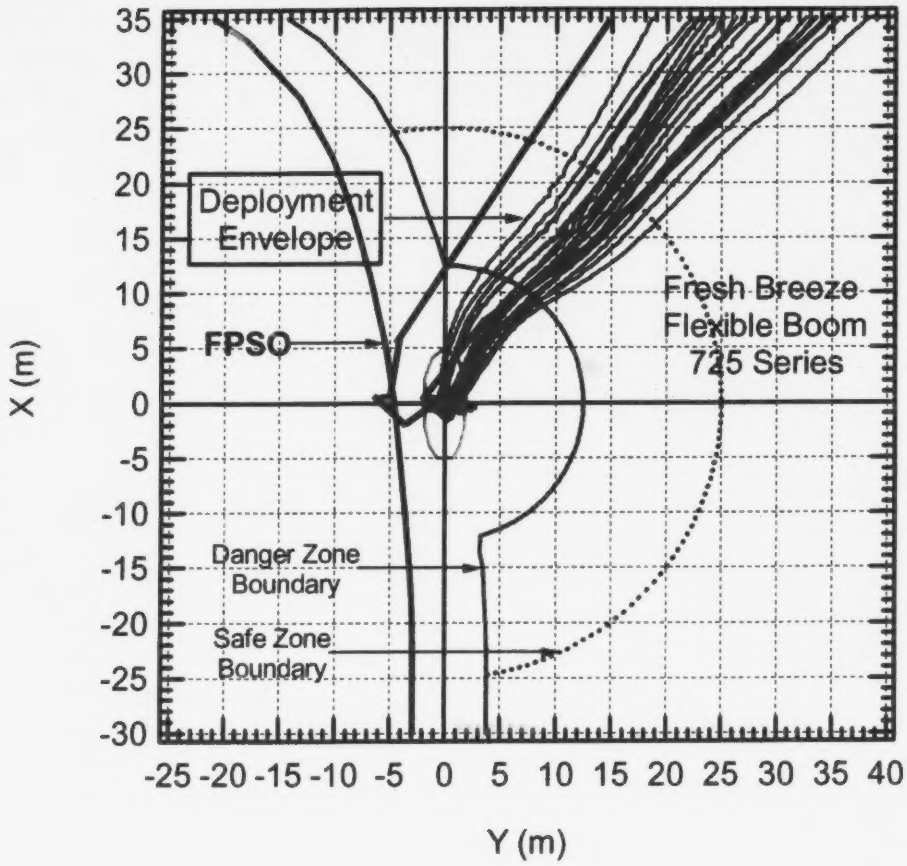

Figure 10.20 – Fresh Breeze, Plan View of Deployment Envelope Flexible Boom System

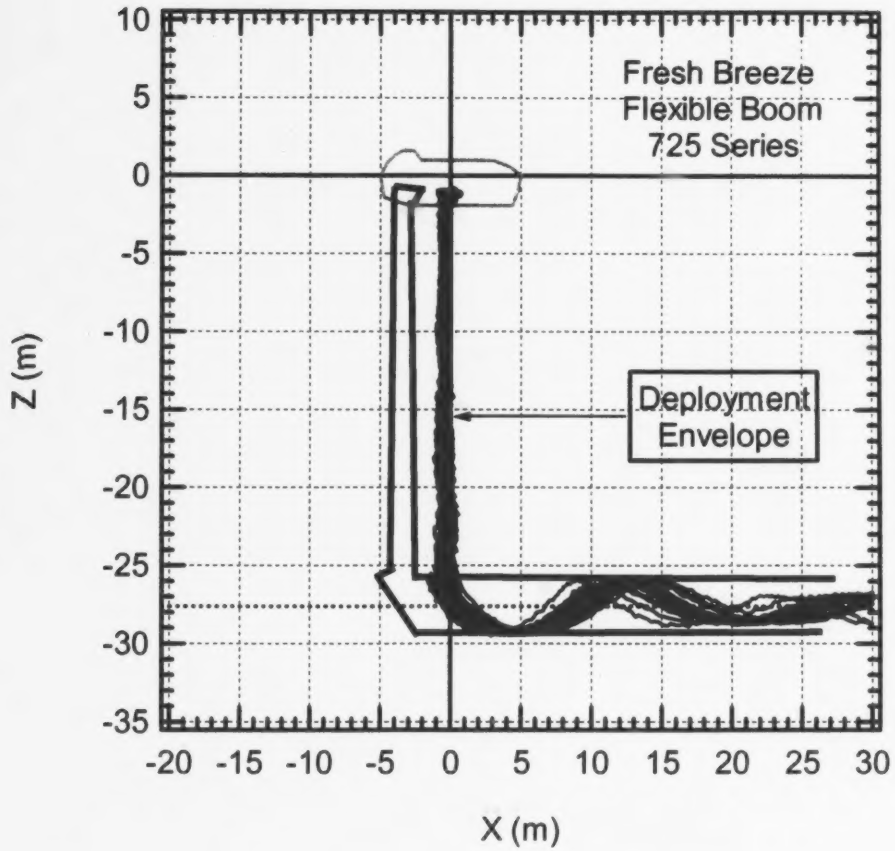

Figure 10.21 – Fresh Breeze, Outboard Profile of Deployment Envelope
Flexible Boom System

In general, platform motions do not appear to be significant in this environmental condition. The individual deployments presented in Appendix 9 show minimal oscillations during the lowering as the TEMPSC swung as a pendulum. Some of this oscillation may be attributable to direct forcing by the wind, but it is mainly due to the motions set up in the platform by the waves.

During the fresh breeze deployments with the flexible boom system the path of the TEMPSC is simple: straight down with minimal motion during lowering, as indicated in Figure 10.21; upon splashdown into the danger zone it sails at an angle of approximately 45° through the intermediate zone to safety, as illustrated in Figure 10.20. The increase in weather from calm to fresh breeze manifests itself in the increased width of the plan view deployment envelope, which indicates reduction of TEMPSC control during sail-away.

Table 10.13 – Summary of Fresh Breeze Deployment Data for Flexible Boom System

	Deployment						Boundary Crossing				Travel Distance		Average Speed			Accelerations		Splashdown			
Run Number	Launch to Splash [s]	Splash to Davit [s]	Splash to Tagline [s]	Davit to Tagline [s]	Launch to Davit [s]	Launch to Tagline [s]	Splash to Danger [s]	Splash to Safe [s]	Danger to Safe [s]	Launch to Safe [s]	Splash to Danger [m]	Danger to Safe [m]	Danger Zone [knots]	Inter. Zone [knots]	Open Sea [knots]	Launch to Splash [g]	Sail away [g]	On Wave	Missed target [m]	Set-back [m]	Combined miss/set [m]
725_002	27.90	0.90	11.60	10.70	28.80	39.50	9.33	12.90	3.58	40.80	14.50	12.25	3.02	6.66	5.90	0.08	0.22	C	0.564	0.813	1.339
725_003	26.50	0.00	9.00	9.00	26.50	35.50	5.88	9.56	3.68	36.06	13.50	12.75	4.47	6.73	9.50	0.04	0.09	C	0.303	0.000	0.303
725_004	29.40	1.50	7.80	6.30	30.90	37.20	8.97	12.65	3.68	42.05	13.00	12.25	2.82	6.47	7.40	0.06	0.14	C	0.632	0.000	0.632
725_005	26.80	0.00	8.60	8.60	26.80	35.40	7.27	10.85	3.58	37.65	13.50	13.00	3.61	7.07	8.40	0.02	0.11	C	0.261	0.000	0.261
725_006	25.60	1.10	9.80	8.70	26.70	35.40	7.70	11.27	3.58	36.87	12.75	12.50	3.22	6.80	8.50	0.12	0.51	C	0.297	0.000	0.297
725_007	30.00	-2.50	11.90	14.40	27.50	41.90	8.39	12.18	3.79	42.18	13.00	12.50	3.01	6.42	8.20	0.12	0.27	T	1.243	0.000	1.243
725_008	29.80	-0.30	10.30	10.60	29.50	40.10	8.01	11.59	3.58	41.39	14.75	12.50	3.58	6.80	8.80	0.07	0.11	U	0.706	0.987	0.340
725_009	28.70	1.00	11.60	10.60	29.70	40.30	8.17	11.54	3.37	40.24	14.25	12.50	3.39	7.22	8.10	0.10	0.13	U	0.454	0.561	0.982
725_010	28.20	0.80	10.60	9.80	29.00	38.80	8.50	12.07	3.58	40.27	14.00	12.50	3.20	6.80	8.10	0.11	0.11	C	0.506	0.833	1.170
725_011	29.30	-2.20	11.10	13.30	27.10	40.40	9.55	13.23	3.68	42.53	13.25	12.50	2.70	6.60	7.70	0.06	0.17	T	0.627	1.047	0.763
725_013	30.30	-1.10	12.20	13.30	29.20	42.50	9.47	13.05	3.58	43.35	13.00	12.75	2.67	6.93	7.50	0.06	0.38	T	1.987	0.000	1.987
725_014	26.50	1.40	9.70	8.30	27.90	36.20	6.41	9.99	3.57	36.49	13.25	12.50	4.02	6.80	9.00	0.08	0.14	C	0.151	0.000	0.151
725_016	28.00	1.70	10.50	8.80	29.70	38.50	7.69	11.06	3.36	39.06	13.50	12.50	3.41	7.22	8.40	0.09	0.09	C	0.470	0.237	0.626
725_017	26.80	1.30	9.20	7.90	28.10	36.00	6.54	10.12	3.58	36.92	14.00	13.00	4.16	7.07	8.70	0.08	0.02	C	0.421	0.000	0.421
725_018	27.20	0.80	11.20	10.40	28.00	38.40	7.67	11.03	3.37	38.23	14.25	12.50	3.61	7.22	8.40	0.11	0.06	C	0.349	0.537	0.886
725_019	28.90	1.20	10.90	9.70	30.10	39.80	9.38	12.85	3.47	41.75	13.75	12.50	2.85	7.00	8.00	0.06	0.11	U	0.349	1.454	1.253
725_020	27.30	4.50	11.30	6.80	31.80	38.60	7.71	11.29	3.58	38.59	13.50	12.50	3.40	6.80	8.40	0.08	0.06	C	0.196	0.454	0.457
725_021	26.30	0.90	8.80	7.90	27.20	35.10	5.56	9.24	3.68	35.54	13.50	13.25	4.72	7.00	8.60	0.11	0.09	D	0.292	0.000	0.292
725_022	26.50	0.20	9.60	9.40	26.70	36.10	6.41	9.99	3.58	36.49	13.25	13.00	4.02	7.07	8.40	0.12	0.42	C	0.036	0.000	0.036

C – Crest T – Trough U – Up-slope D – Down-slope

10.4.3 800 Series – Fresh Gale
Flexible Boom TEMPSC Deployment

The 800 series – fresh gale – deployments for the flexible boom system were performed for the FPSO in the intact condition and with a heading of 20° to the waves and 57° to the wind. A total of 19 deployments were performed. The individual experiments were run following the same procedure and illustrate the flexible boom evacuation system operation in a fresh gale. The data are for the lowering of the TEMPSC to the water surface and the sail-away to the safe boundary zone. The data collected are for both the time to carry out the process and the path length taken to accomplish it.

The fresh gale data are tabulated in Table 10.14 with the overall effect of the environment on the control of the TEMPSC during the evacuation shown in Figures 10.22 and 10.23. These are presented as envelopes encompassing the paths taken by the TEMPSC in each deployment from the lowering to the crossing of the safe boundary zone and beyond. The data for FPSO motions, TEMPSC location, wind and waves together with the detailed video analysis are presented in Appendix 9 for the individual test runs.

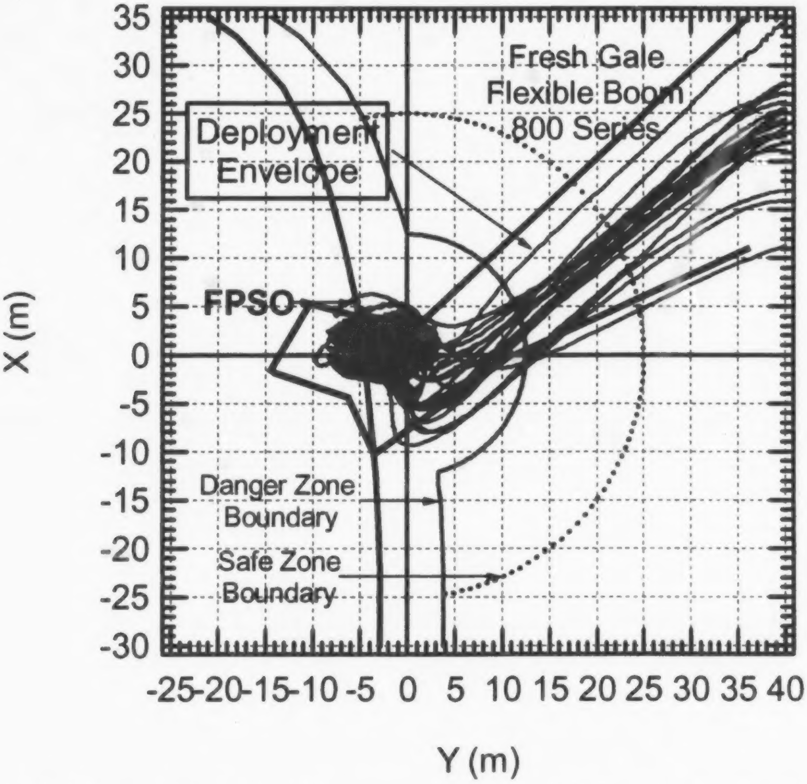

Figure 10.22 – Fresh Gale, Plan View of Deployment Envelope Flexible Boom System

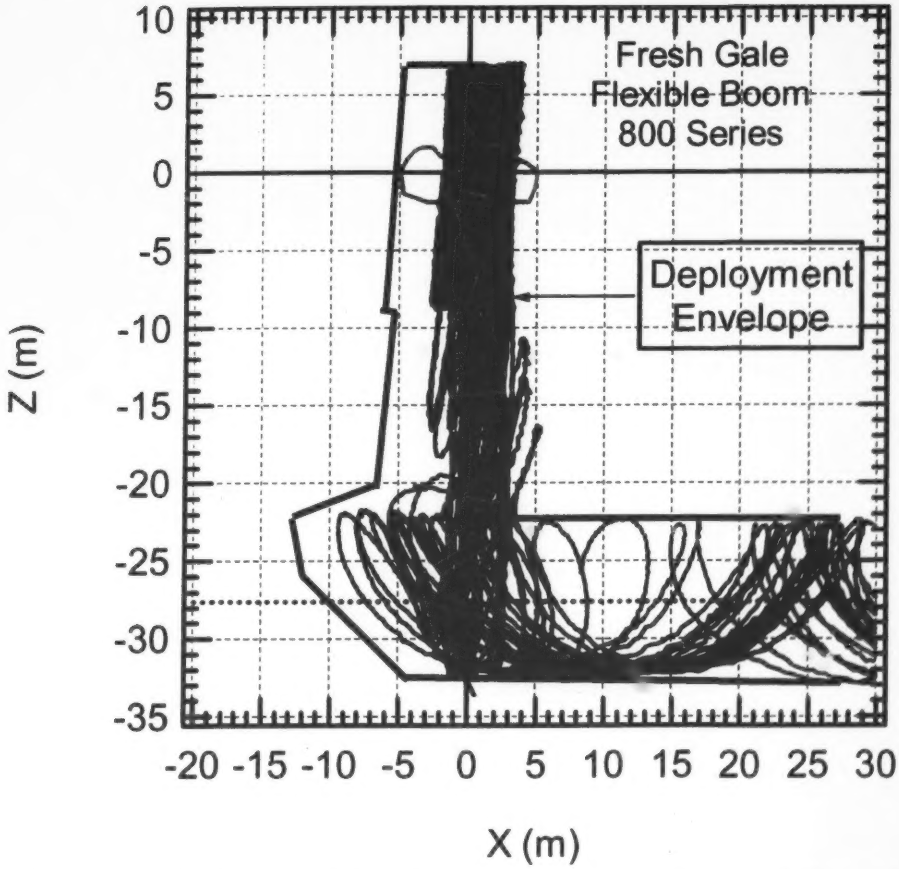

Figure 10.23 – Fresh Gale, Outboard Profile of Deployment Envelope
Flexible Boom System

Platform motions are severe in this environmental condition. The individual deployments presented in Appendix 9 show oscillations in the z-axis in the range of ±8 m prior to the lowering and oscillatory pendulum-like motions of about 5 m or more amplitude in the x-axis during the lowering. The oscillatory motions are induced by the FPSO with the wind force having a minor contribution.

Table 10.14 – Summary of Fresh Gale Deployment Data for Flexible Boom System

Run Number	Deployment						Boundary Crossing				Travel Distance		Average Speed			Accelerations		Splashdown			
	Launch to Splash [s]	Splash to Davit [s]	Splash to Tagline [s]	Davit to Tagline [s]	Launch to Davit [s]	Launch to Tagline [s]	Splash to Danger [s]	Splash to Safe [s]	Danger to Safe [s]	Launch to Safe [s]	Splash to Danger [m]	Danger to Safe [m]	Danger Zone [knots]	Inter. Zone [knots]	Open Sea [knots]	Launch to Splash [g]	Sail away [g]	On Wave	Missed target [m]	Set-back [m]	Combined miss/set [m]
800_001	22.60	1.20	11.90	10.70	23.80	34.50	7.75	10.17	2.42	32.77	18.25	14.25	4.58	11.45	12.80	0.08	1.41	U	6.321	5.443	11.578
800_002	26.80	1.50	8.40	6.90	28.30	35.20	2.64	5.37	3.80	32.17	15.50	13.50	11.43	6.91	11.80	0.09	1.12	U	9.471	0.086	9.418
800_003	22.80	1.30	10.70	9.40	24.10	33.50	6.14	6.14	6.30	28.94	16.00	13.00	5.07	4.01	12.80	0.09	0.97	U	6.738	1.937	8.611
800_005	28.60	-0.50	12.80	13.30	28.10	41.40	13.74	16.05	2.31	44.65	21.50	12.50	3.04	10.50	13.30	0.60	1.08	T	3.837	6.635	4.030
800_006	24.90	1.20	11.30	10.10	26.10	36.20	2.94	8.19	5.70	33.10	16.50	14.50	10.93	4.95	10.80	0.08	0.70	U	8.700	3.305	11.982
800_007	23.30	-0.70	10.60	11.30	22.60	33.90	6.32	8.64	2.31	31.94	18.50	13.00	5.69	10.92	13.00	0.04	0.97	U	6.386	3.545	9.664
800_008	31.40	0.20	13.80	13.60	31.60	45.20	11.10	14.25	3.16	45.65	23.50	12.50	4.12	7.70	10.30	0.17	0.94	T	4.776	0.463	5.131
800_009	27.30	0.10	11.80	11.70	27.40	39.10	4.21	6.32	2.10	33.62	12.50	12.50	5.77	11.55	13.70	0.91	0.17	T	4.375	0.000	4.375
800_010	25.90	0.50	12.80	12.30	26.40	38.70	4.64	7.16	3.90	33.06	13.50	13.00	5.66	6.48	13.30	0.62	0.85	T	7.429	2.708	9.991
800_011	30.00	0.10	13.20	13.10	30.10	43.20	10.85	13.90	3.05	43.90	26.25	12.25	4.70	7.81	9.60	0.12	0.96	T	2.631	0.000	2.631
800_012	27.30	0.60	13.00	12.40	27.90	40.30	3.13	6.18	3.80	33.48	17.00	12.50	10.56	6.39	10.90	0.81	0.16	U	8.279	0.464	8.727
800_013	33.65	0.52	13.85	13.32	34.18	47.50	8.61	11.55	2.94	45.21	37.50	12.25	8.47	8.09	10.60	0.21	1.21	T	5.623	0.194	5.776
800_014	28.00	0.90	12.80	11.90	28.90	40.80	2.81	5.23	3.10	33.23	11.00	12.50	7.60	7.84	12.30	0.97	0.06	T	9.711	0.140	9.624
800_015	23.80	4.60	23.90	19.30	28.40	47.70	17.55	20.92	3.37	44.72	29.50	12.50	3.27	7.22	10.50	0.06	0.90	T	8.540	0.084	8.623
800_016	23.50	0.90	9.80	8.90	24.40	33.30	5.88	8.61	2.73	32.11	17.00	12.50	5.62	8.88	9.70	0.09	1.36	U	6.979	1.561	8.537
800_017	23.10	0.30	9.90	9.60	23.40	33.00	6.71	8.92	2.21	32.02	16.75	13.00	4.85	11.44	12.90	0.08	1.05	U	7.658	2.184	9.833
800_018	23.50	0.30	11.20	10.90	23.80	34.70	5.57	9.26	3.68	32.76	18.50	14.50	6.45	7.66	12.30	0.08	0.94	U	8.800	4.057	12.857
800_020	28.30	-1.40	10.30	11.70	26.90	38.60	1.95	4.79	4.50	33.09	13.00	13.00	12.97	5.62	12.90	0.69	1.05	T	11.429	0.000	11.429
800_021	23.00	0.50	11.70	11.20	23.50	34.70	5.78	8.41	2.63	31.41	17.00	13.25	5.72	9.80	11.80	0.04	1.09	T	5.865	2.939	8.752
900_006	23.10	3.20	11.40	8.20	26.30	34.50	6.62	8.72	2.10	31.83	12.75	13.25	3.74	12.25	12.80	0.07	1.07	U	6.284	2.694	8.915

C – Crest   T – Trough   U – Up-slope   D – Down-slope

11.0 CONCLUSIONS

The work presented in this report has two main concerns: to evaluate TEMPSC evacuation capabilities as a function of weather conditions; to evaluate the use of model testing as a tool for such safety studies.

The model experiment program was carried out using an FPSO as a platform from which evacuation by lifeboat was tested. A total of 153 launches were made using two evacuation systems: a conventional twin falls davit launched TEMPSC and the same system with the addition of a flexible boom. The evacuation systems were adequate models of the prototypes as every effort was made to scale as many components as possible for the tests.

The FPSO was set with heading of 20° to the waves and 57° to the wind for environmental conditions ranging from calm (Beaufort 0) to fresh gale (Beaufort 8). The davit and the boom-assisted systems were tested over the above range of weather conditions and their performance found to deteriorate as weather conditions worsened.

The motion characteristics of the FPSO selected for these series of experiments compare well to those of other similar hull designs thus ensuring that the TEMPSC deployments were performed from a realistic platform.

Model tests proved to be a suitable tool for the investigation. Indeed, where extreme weather events are of interest, physical model testing offers a reliable and safe means of performance evaluation. Several modeling issues were raised in the course of the work, specifically relating to the effects of wave steepness and the relationship between setback and the drop point on the wave. The former will be investigated in future experiments; more insight into the latter might be gained from a closer look at the current test data and statistics.

The test program did not include launches from the installation in any damaged conditions, which would be worthwhile to consider in future. The motions of the platform were found to have a major influence on the motion of the TEMPSC during launching and, while the analysis still showed clear trends in many of the proposed performance measures, it would be easier to discern launch system effects from platform effects if the platform were fixed, rather than floating. To this list of modeling issues can be added scale effects, which are always a concern in experimental modeling.

Several measures of performance are proposed and these are used to quantify the relationship between weather and the evacuation system's capabilities.

The test results for each series are summarized as the minimum, maximum, mean, and mean ± 1 standard deviation for different performance measures and plotted against the corresponding mean weather conditions.

The twin falls davit evacuation missed target data from all six test series are plotted against mean wave height and illustrated in Figure 11.1. Also shown in this figure are a few basic trends in the data, specifically the line through the mean of each test series (the set of data at a given weather condition), and the lines through the series' mean ± 1 standard deviation. One performance measure is shown in each of the next 10 figures.

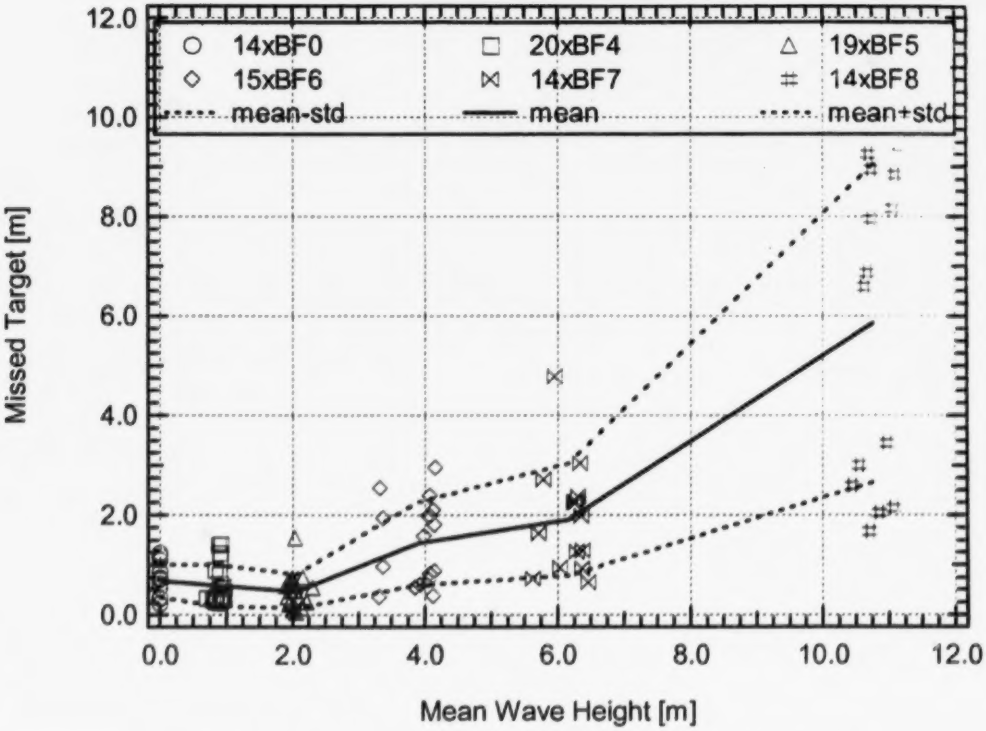

Figure 11.1 – Missed Target in Different Environments

The mean time from the start of lowering to splashdown is shown in Figure 11.2. Since the lowering was done at a nominally constant rate for all the tests, this should be a flat line, independent of weather. This is not quite the case, as the time taken in rougher weather is slightly shorter than in light weather. This might be explained by the fact that most deployments occurred at either wave up-slopes or wave crests; in matter of fact, of the 120 deployments in waves 80 took place at either wave up-slope or wave crest. This would effectively reduce the lowering distance, and consequently the time.

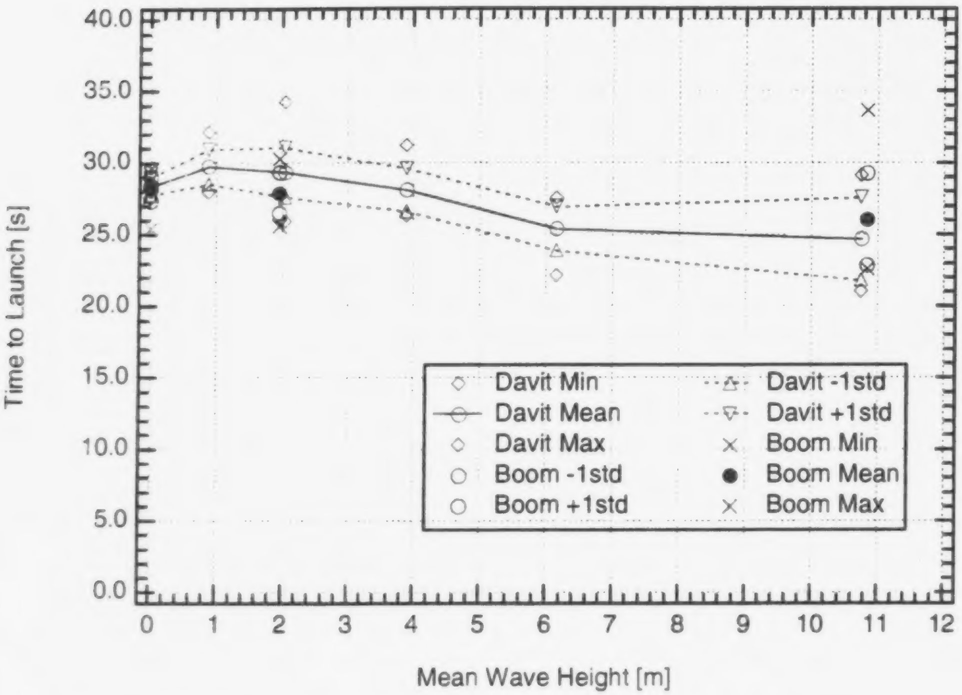

Figure 11.2 – Mean Time from Start of Launch to Splashdown

The time taken to release the falls after splashdown is presented in Figure 11.3. As expected, weather appears to have little effect on this, although again, the release was executed slightly more quickly in rougher conditions than in calm water. A closer look at the figure shows that some of the times are actually negative, which means that the falls were released prior to splashdown. This situation developed when a wave crest hit the TEMPSC. This sent a signal to the falls to be released, but as the wave crest passed the TEMPSC became air borne once again. There is a mechanical delay from the time the hydrostatic release is activated and the blocks actually open. This delay is on the order of 2 to 3 seconds full scale. The significance here is that a wave may travel from half to a full TEMPSC length in one second. The combination of incoming wave speed, platform motion, TEMPSC lowering speed, and falls mechanical delay results in these unique cases. The TEMPSC subsequently dropped in free fall into a trough for splashdown.

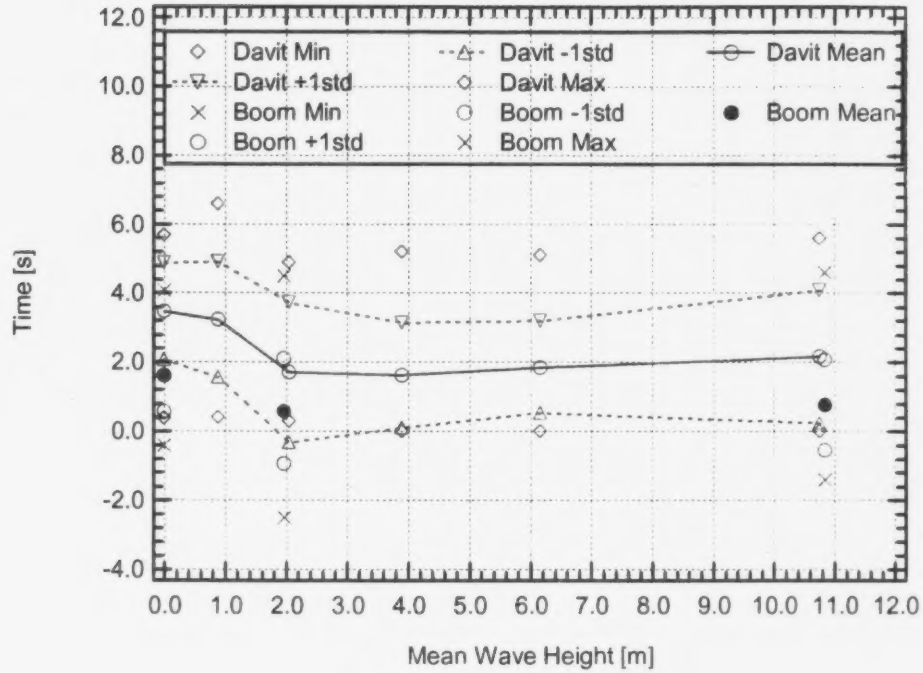

Figure 11.3 – Time from Splashdown to Davit Release

In Figure 11.4, the time taken by the TEMPSC to cross the safe boundary zone from the splashdown is studied. It is clear that there is little weather dependency; in fact, the speed of the lifeboat in rough weather conditions tended to increase compared to lighter conditions. Why this occurred is unclear, but it may be related to the surfing action of the TEMPSC on waves' down-slopes. A simpler explanation may be that the propeller speed control was coarse and provided poor rpm control. This is a model setup deficiency rather than a TEMPSC weakness.

The distance covered by the TEMPSC as it cleared the danger zone after splashdown is presented in Figure 11.5. That distance traveled increases with weather indicates that there is some drift or loss of steerage during this phase. A look at the some of the path plots, say the strong breeze in Appendix 9, shows that this effect is most common just after splashdown when the TEMPSC is accelerating. Once the TEMPSC is at speed, the weather has less effect on its ability to make way. This interpretation is reinforced by the plot in Figure 11.6, which shows the distance covered by the TEMPSC as it passed from the danger boundary to safety: during this phase it was typically at speed and making way without as much influence by the weather.

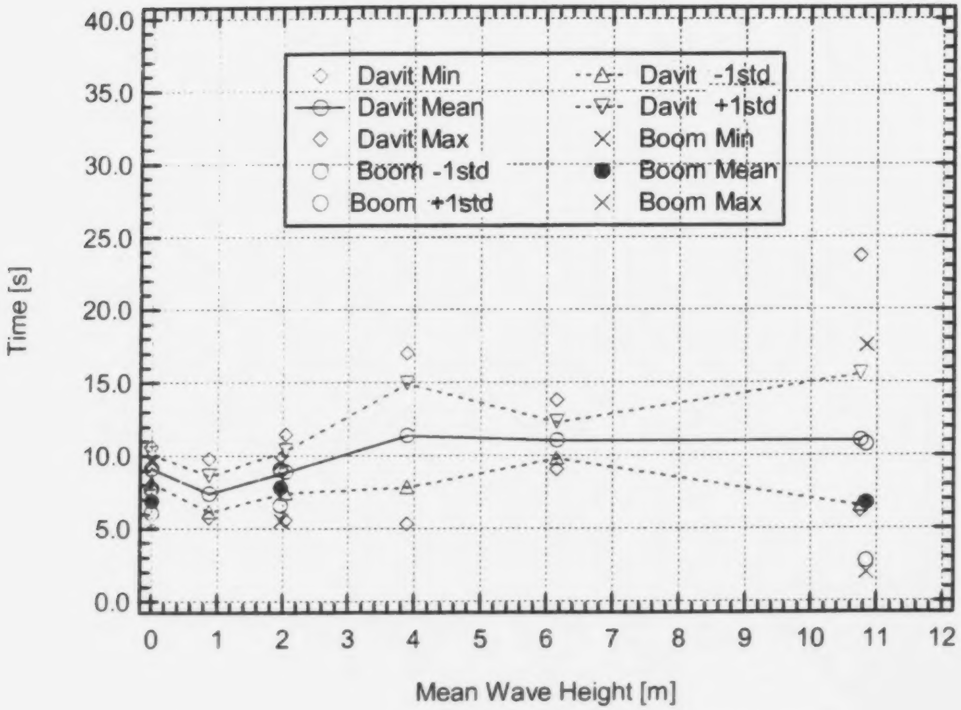

Figure 11.4 – Time from Splashdown to Safety Zone

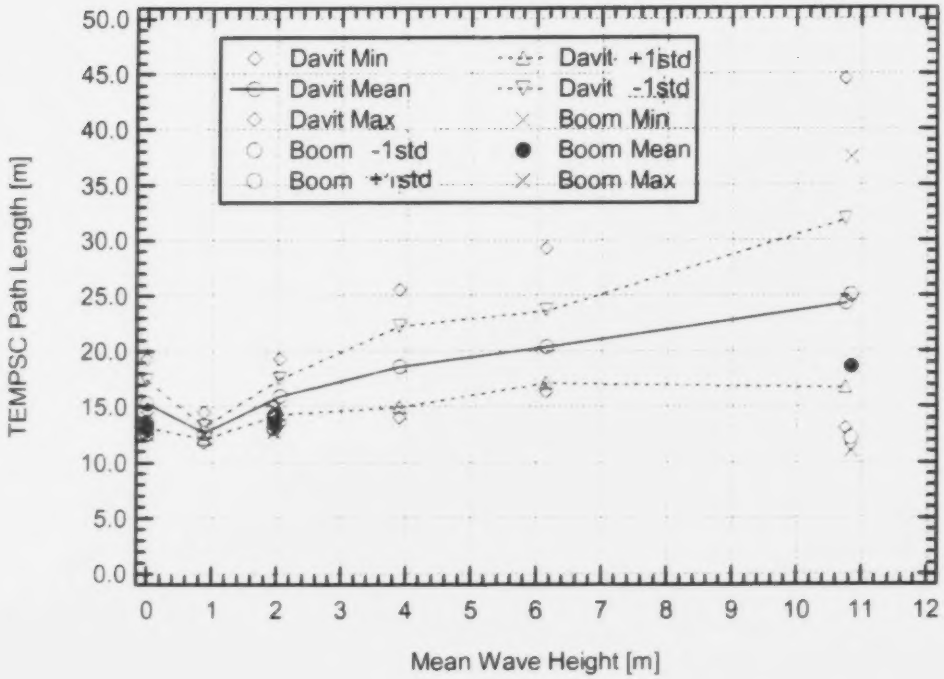

Figure 11.5 – TEMPSC Path Length from Splashdown to Safety Boundary Zone

The effect of the boom can be seen in Figure 11.5. Compared with the basic system, the boom system's path lengths are shorter. This is due to the initial steerage provided by the boom, and the application of the tagline force, which mitigates the drift at splashdown. Any advantage of the boom over the basic system is lost once the tagline is released.

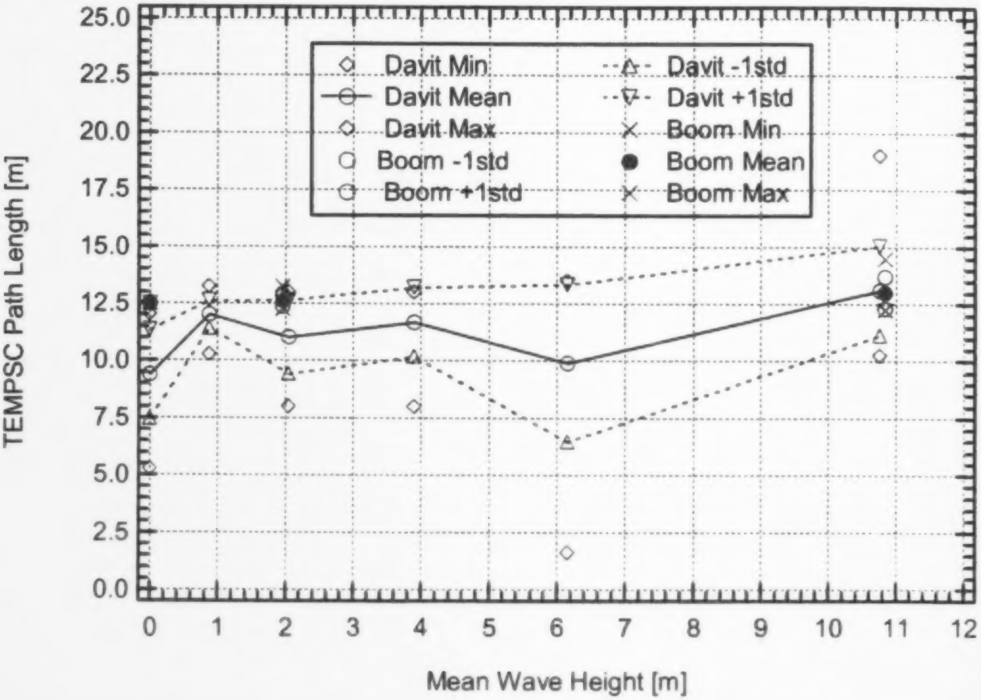

Figure 11.6 – TEMPSC Path Length from Danger to Safety Zone

A comparison of the two systems in Figure 11.6 (path length from danger zone boundary to safety zone boundary) supports the expectation: the difference in path lengths from danger to safety is negligible. Such results give us more confidence in the utility of model testing as an effective tool for safety investigations.

The weather effect on the launch performance in terms of the combination of missed target plus setback position is illustrated in Figure 11.7. Target here is defined as the point under the davit at the start of lowering and setback as the backwards movement of the TEMPSC after splashdown due to the incoming wave. Ideally, the distance between the target and splashdown is zero. The figure shows that the extent that the target is missed and the TEMPSC is set back increases with increasing weather, as might be expected. In practical terms this is to be avoided or mitigated, as excessive movement of the TEMPSC towards the FPSO can result in collisions. The combination of missed target plus setback position is presented in terms of distance in the XY plane.

In Figure 11.7 it seems that the boom does not reduce missed target but plays a significant role in reducing setback. The results presented in the figure are representative in general of all the tests in each respective series; however an important factor in the magnitude of the setback is not shown: the location on the wave of splashdown.

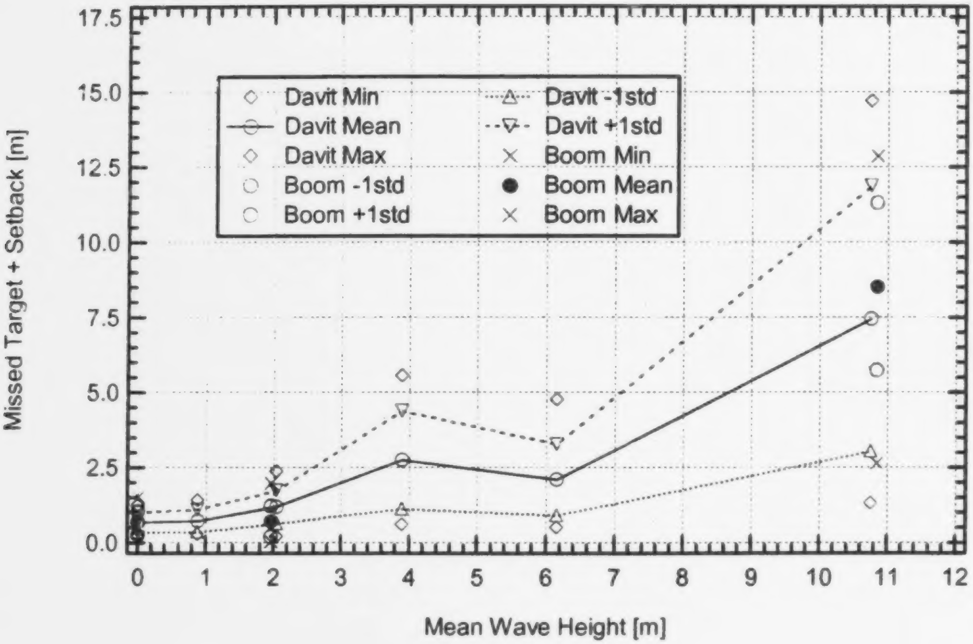

Figure 11.7 – Missed Target + Setback

The lateral accelerations measured in the TEMPSC during sail-away are summarized in Figure 11.8. As expected, accelerations increase with weather. The most interesting feature of this figure is that the accelerations of the TEMPSC launched with the boom appear to be higher than those of the conventionally launched TEMPSC. This could be due to the fact that the boom orients the TEMPSC away from the FPSO, which coincides in this test setup with directing it towards beam seas.

The oscillation angles of the TEMPSC during deployment are shown in Figure 11.9. These are derived from the measurements of the TEMPSC's motion and include all significant excursions due to pendulum motions during lowering. Only the means and maximums are shown for the basic system, both of which show a strong dependence on weather.

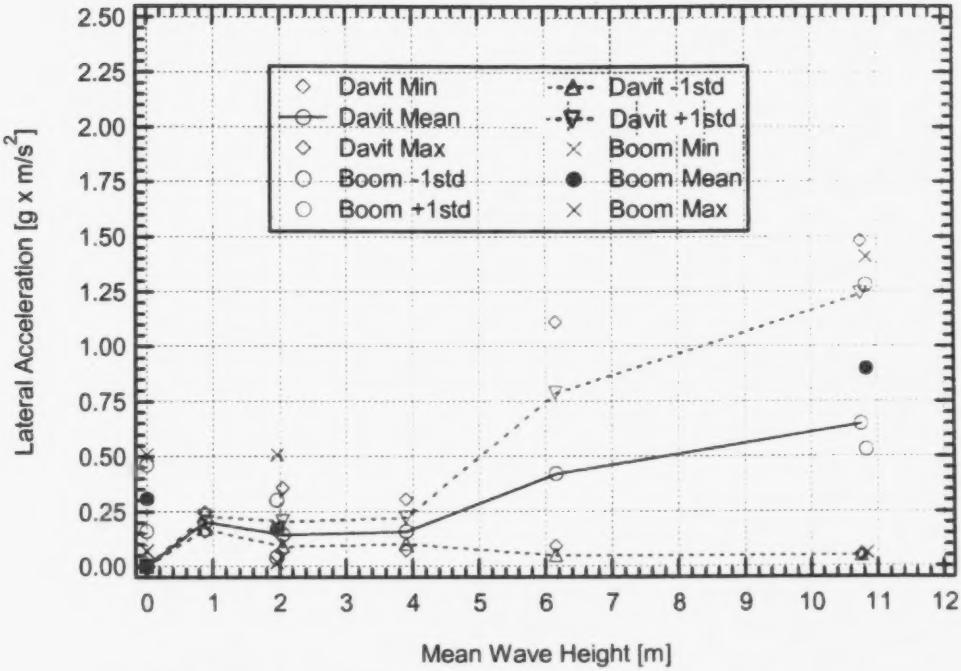

Figure 11.8 – Lateral Accelerations During Sail-Away

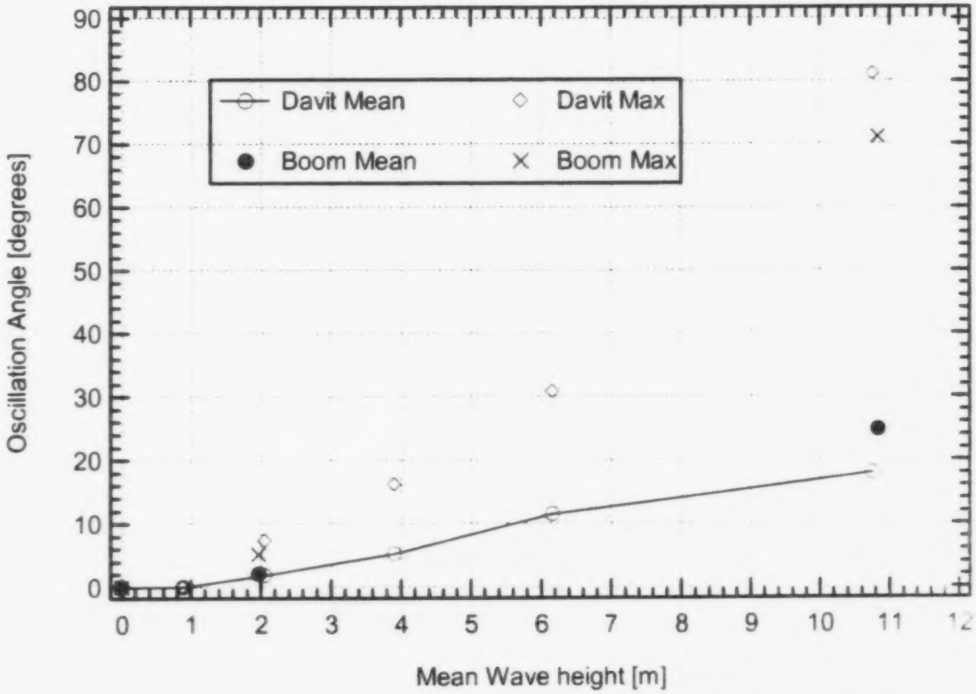

Figure 11.9 – Oscillation Angles During TEMPSC Lowering

The overall effects of weather conditions on the control of the TEMPSC path during evacuation are summarized in Figure 11.10. The figure shows generalized envelopes that encompass the paths taken by the TEMPSC in each set of tests. Figure 11.10 is a summary of Figures 10.6 to 10.23. The paths in two views are shown: the plan view shows sail-away on top, and the outboard profile shows lowering, setback, and sail-away on bottom.

The first six pairs of envelopes correspond to the basic davit launch configuration and the last three are for the boom-assisted configuration. The most obvious trend is that control deteriorates radically with weather, regardless of the evacuation system used. This can be attributed to the weather alone in the sail-away phase, and to the combined effects of weather and platform motions in the lowering phase.

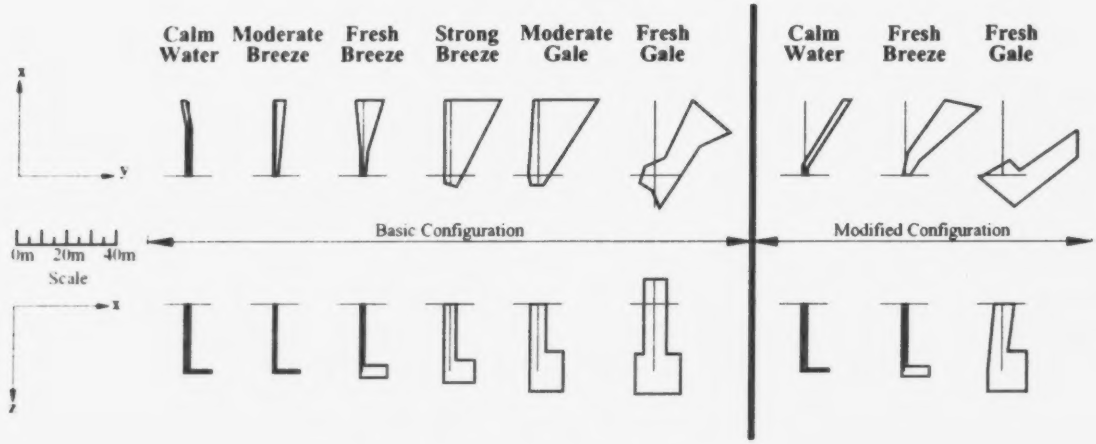

Figure 11.10 – Path Envelopes in Sail-Away Phase (plan view at top) and Lowering and Sail-Away Phases (outboard profile).

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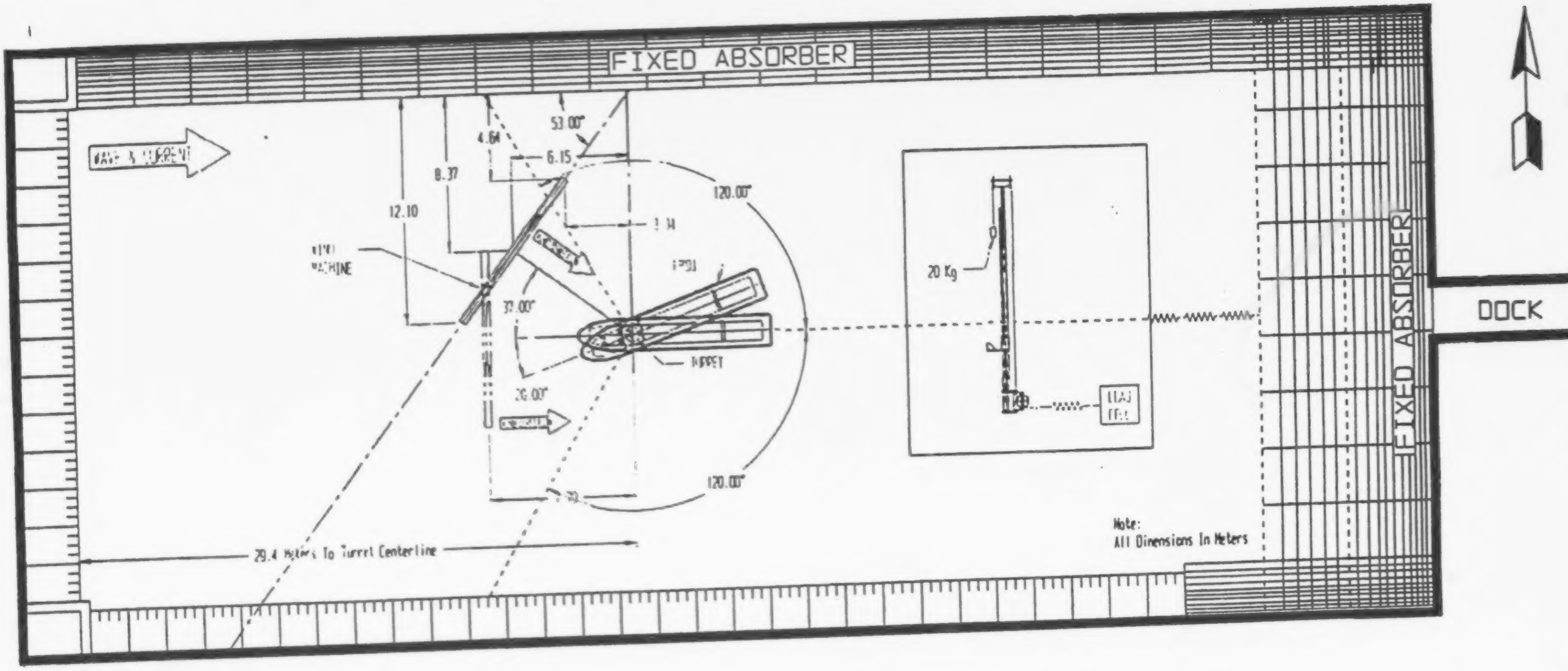
Appendix 1 General Layout of the Offshore Engineering Basin

LOCATION OF FPSO



Appendix 2 FPSO Drawings, Hydrostatics and Mass Properties

BALLAST CONDITION

HYDROSTATICS WITHOUT APPENDAGES

Scale 27.65

		Model
LENGTH BETWEEN PERPENDICULARS, m	277.00	10.02
LENGTH ON THE WATERLINE, m	273.47	9.89
LENGTH OVERALL, m	291.61	10.55
MAXIMUM WATERLINE BEAM, m	44.65	1.61
DRAFT AT MIDSHIPS, m	12.34	0.45
DRAFT ABOVE DATUM AT AFT PERPENDICULAR, m	12.81	0.46
DRAFT ABOVE DATUM AT FWD PERPENDICULAR, m	11.87	0.43
TRIM, deg.	0.19	0.19
EQUIVALENT LEVEL KEEL DRAFT ABOVE BASELINE, m	12.37	0.45
PARALLEL MIDDLE BODY WRT AP, m	66.90	2.42
TO, m	201.80	7.30
CENTRE OF BUOYANCY WRT AP, m	137.36	4.97
CENTRE OF BUOYANCY ABOVE BASELINE, m	6.61	0.24
CENTRE OF FLOTATION WRT AP, m	129.70	4.69
WATERPLANE AREA, sq. m	11404.70	14.92
WETTED SURFACE AREA, sq.m	16060.61	21.01
MIDSHIP SECTIONAL AREA, sq.m	527.90	0.69
TRANSVERSE METACENTRIC RADIUS, m (BMt)	14.87	0.54
LONGITUDINAL METACENTRIC RADIUS, m (BML)	533.61	19.30
VOLUME OF DISPLACEMENT, cu. m	119179.16	5.64
DISPLACEMENT, (tonnes @ FS in SW)(kg @ MS in FW)	122158.63	5637.87

MASS PROPERTIES

CENTER OF GRAVITY ABOVE BASELINE, m	18.04	0.65
TRANSVERSE METACENTRE HEIGHT, m (GMt)	3.44	0.12
LONGITUDINAL METACENTRE HEIGHT, m (GML)	522.17	18.89

APPENDAGES

BILGE KEELS

CENTRE OF BUOYANCY WRT AP, m	132.75	4.80
VOLUME OF DISPLACEMENT, cu. m	NA	NA
WETTED SURFACE AREA, sq.m	520.5	0.681

BALLAST CONDITION

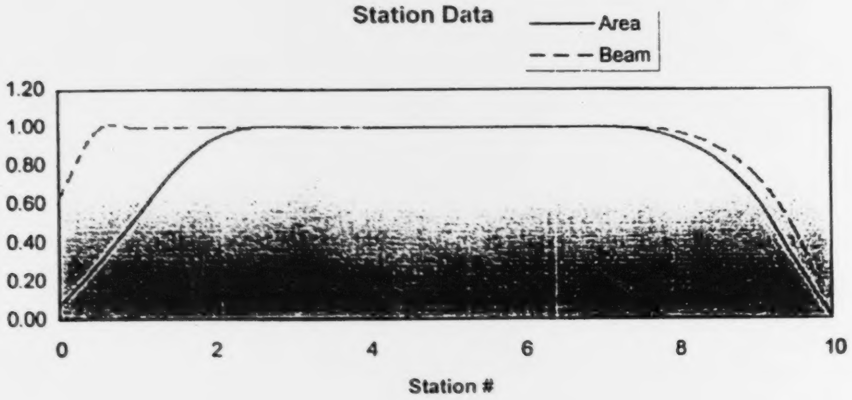
COEFFICIENTS OF FORM FOR NAKED HULL

COEFFICIENTS BASED ON:	LENGTH ON WATERLINE MAXIMUM BEAM EQUIVALENT LEVEL KEEL DRAFT
L/B	6.205
L/T	22.393
B/T	3.609
LCB %L FORWARD OF AP	49.589
LCF %L FORWARD OF AP	46.823
BLOCK COEFFICIENT	0.779
MIDSHIP COEFFICIENT	0.958
PRISMATIC COEFFICIENT	0.815
WATERPLANE COEFFICIENT	0.922
LONGITUDINAL INERTIA OF WATERPLANE	0.863
TRANSVERSE INERTIA OF WATERPLANE	0.804
BM/B	0.333
BML/L	11.952
BEAM - DISPLACEMENT RATIO	0.907
DRAFT - DISPLACEMENT RATIO	0.251
LENGTH - DISPLACEMENT RATIO	5.631
WETTED SURFACE - DISPLACEMENT RATIO	6.629
BM - DISPLACEMENT RATIO	0.302
BML - DISPLACEMENT RATIO	10.847

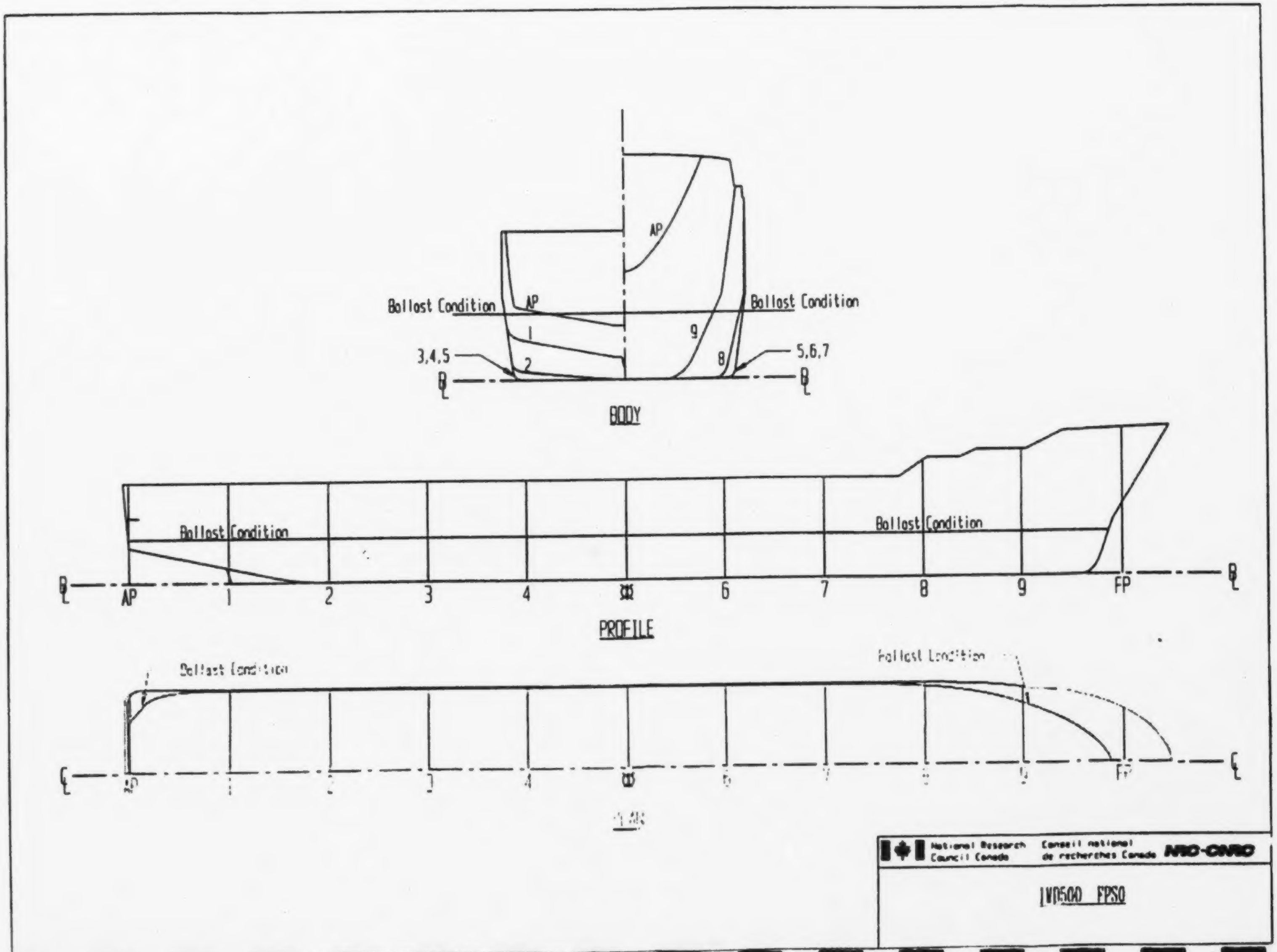
BALLAST CONDITION

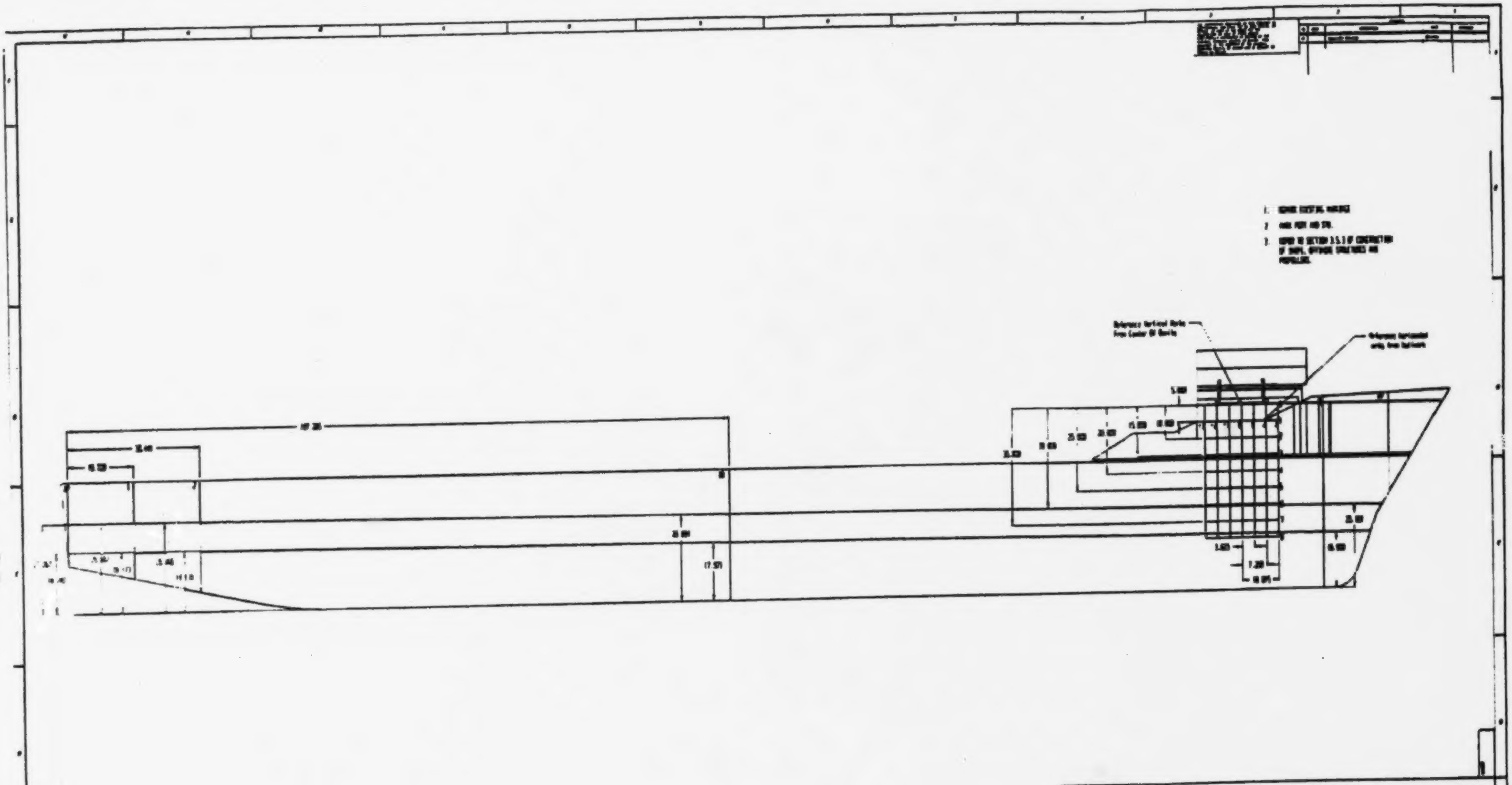
SECTIONAL AREA AND BEAM CURVES

Station	Area	Beam
0	0.071	0.632
0.5	0.288	0.984
1	0.533	1.000
1.5	0.778	1.000
2	0.938	1.000
2.5	1.000	1.000
3	1.000	1.000
3.5	1.000	1.000
4	1.000	1.000
4.5	1.000	1.000
5	1.000	1.000
5.5	1.000	1.000
6	1.000	1.000
6.5	1.000	1.000
7	1.000	1.000
7.5	0.990	0.997
8	0.940	0.972
8.5	0.831	0.899
9	0.635	0.748
9.5	0.315	0.469
10	0.000	0.000



Definitions:
Area = Station Area / Max. Sectional Area
Beam = Station Beam / Max. Section Beam


Ballast Condition
AP
1
2
3,4,5
Ballast Condition
AP
9
8
5,6,7
BODY
Ballast Condition
Ballast Condition
AP
1
2
3
4
6
7
8
9
FP
PROFILE
Ballast Condition
Ballast Condition
AP
FP
PLAN
National Research Council Canada
Conseil national de recherches Canada
NRC-CNRC
IWD500 FPSO



National Research Council Canada
Conseil national de recherches Canada
NRC·CNRC

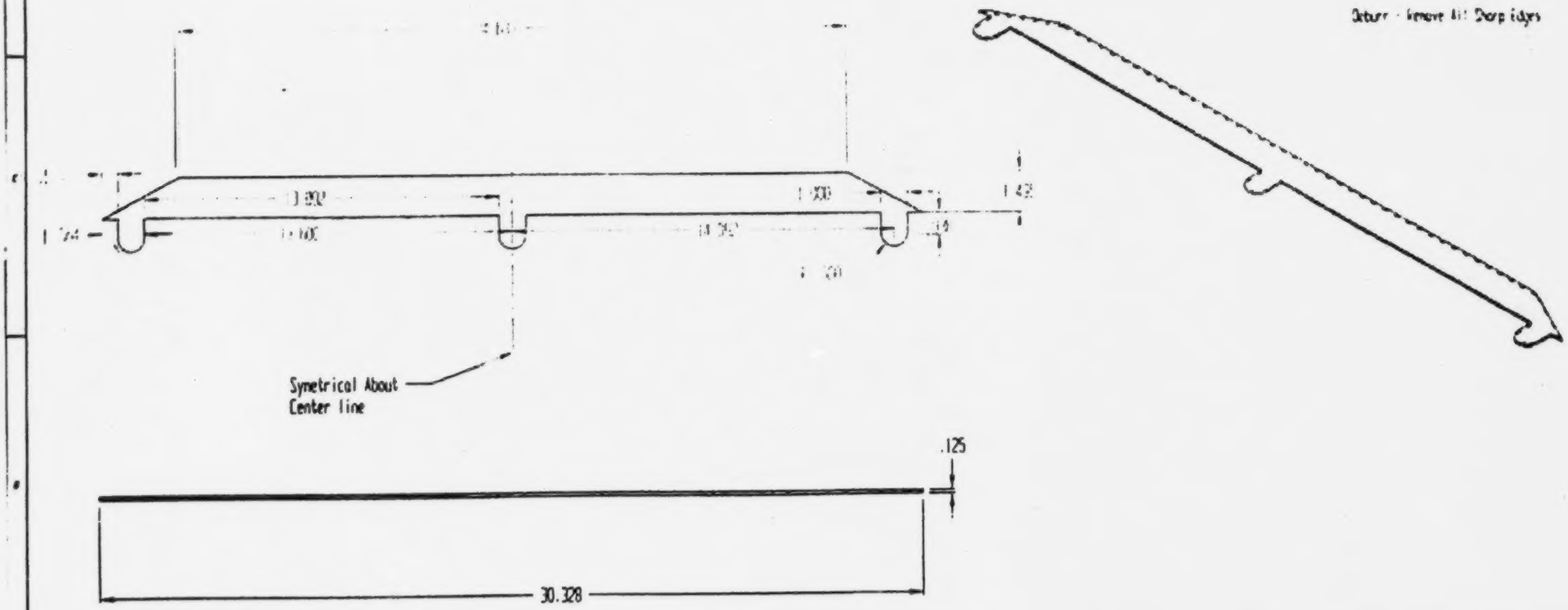
TOLERANCES (unless specified)		
0.X	±	0.03
0.XX	±	0.015
0.XXX	±	0.005
Angle +/-		.5 deg.
Fabrication +/-		.04
Fraction		

Institute for Marine Dynamics
Kerwin Place, P.O. Box 12093, Postal Station A
St. John's, Newfoundland A1B 3T5

913
FPSO MARKING DWG
1 HULL
A1
913400
Quantity 1

Notes:

Deburr - Remove All Sharp Edges



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NRC-CNRC

TOLERANCES
(unless specified)
0.X ± 0.03
0.XX ± 0.015
0.XXX ± 0.005
Angle +/- .5 deg.
Fabrication +/- .04

Material
ALUMINIUM

Institute for Marine Dynamics
Kerwin Place, P.O. Box 12093, Postal Station A
St. John's, Newfoundland A1B 3T5

913
T. Hall
Quantity 12
FPSO BILGE KEELS
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913A02
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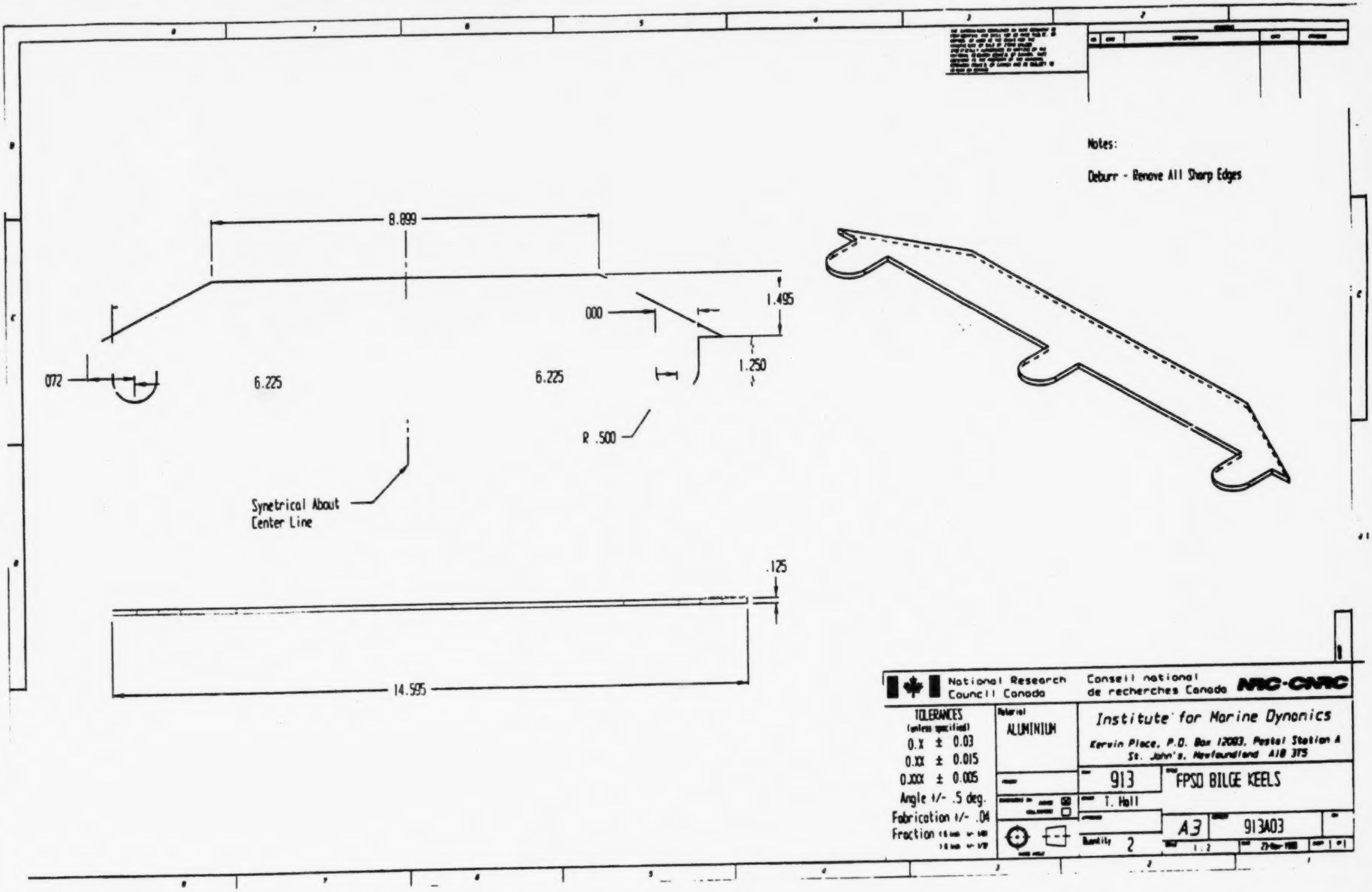
1 of 1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Deburr - Remove All Sharp Edges
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National Research Council Canada
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TOLERANCES (unless specified)
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0.XX ± 0.015
0.XXX ± 0.005
Angle +/- .5 deg.
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Material
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Institute for Marine Dynamics
Kervin Place, P.O. Box 12093, Postal Station A
St. John's, Newfoundland A1B 3T5
913
FPSO BILGE KEELS
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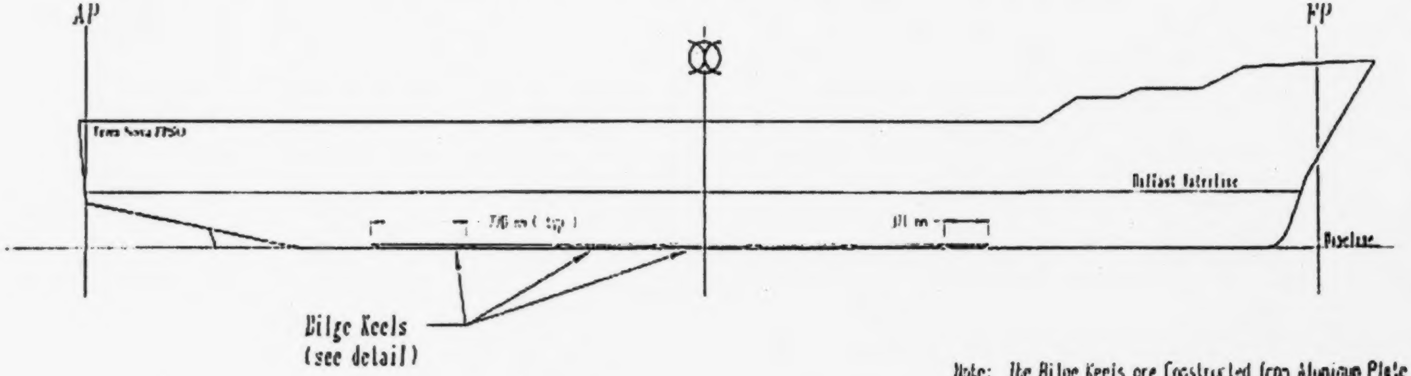
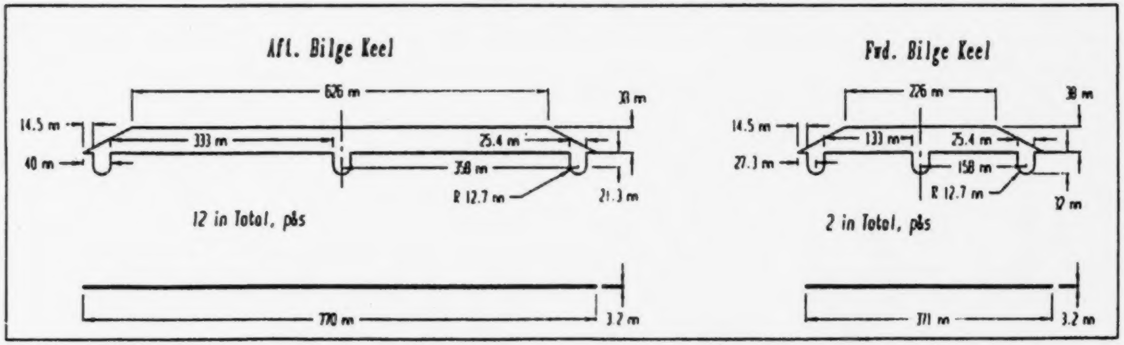
A3
913A03
Quantity 2
1:2

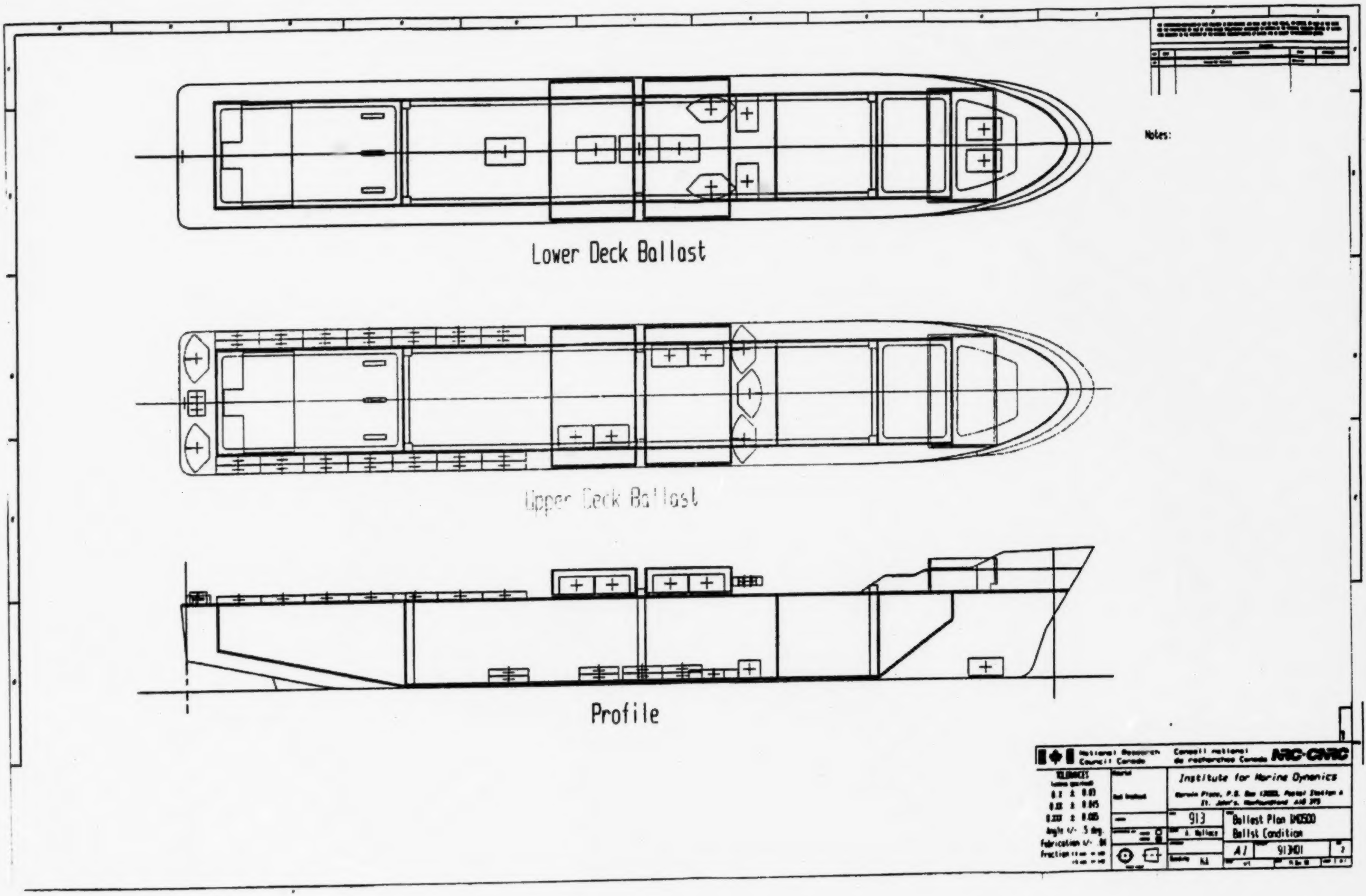
Bilge Keel Arrangement for the FPSO Model



Note: The Bilge Keels are Constructed from Aluminum Plate

Bilge Keel Details




Notes:
Lower Deck Ballast
Upper Deck Ballast
Profile
National Research Council Canada
Conseil national de recherches Canada
NRC·CNRC
TOLERANCES
0.X ± 0.03
0.XX ± 0.015
0.XXX ± 0.005
Angle +/- .5 deg.
Fabrication +/- .01
Institute for Marine Dynamics
St. John's, Newfoundland
913
A. Wallace
Ballast Plan IMD500
Ballst Condition
A1
913401
NA

IMD500 Ballast Plan
Ballast Condition

PROJECT PARTICULARS	
PROJECT DISCRIPTION	Evac Sys
PROJECT NUMBER	913
MODEL DESCRIPTION	FPSO
MODEL NUMBER	IMD500
DATE	28-Feb-00

MODEL PARTICULARS	
LBP (m)	10.018
LOA (m)	10.186
BEAM (m)	1.645
DEPTH MLD (m)	1.020
DRAFT (m)	0.447
DISPLACEMENT (kg)	5637.868

Item	Mass (Kg)	Dimensions			LCG. X. dist from AP (m)	VCG Z. dist from Baseline (m)	TCG Y. dist from Centreline (m)	Long. Moment Mass x X. dist (Kgm)	Vertical Moment Mass x Z. dist (Kgm)	Trans. Moment Mass x Y dist. (Kgm)	Mass Moment Long. (Pitch) (Kgm^2)	Mass Moment Trans. (Roll) (Kgm^2)	X^2*Mass (Kgm^2)	Y^2*Mass (Kgm^2)	Z^2*Mass (Kgm^2)
		X (m)	Y* (m)	Z (m)											
Lightship	1291.400	N/A	N/A	N/A	4.735	0.580	0.000	6114.908	749.012	0.000	10128.268	391.000	28954.702	0.000	434.427
Deck House	90.000	0.000	0.000	0.000	8.956	1.468	0.000	806.040	132.120	0.000	0.000	0.000	7218.894	0.000	193.952
								0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Moveable Ballst Box (AFT)	29.800	0.000	0.000	0.000	4.700	1.120	0.000	140.060	33.376	0.000	4.000	8.580	658.282	0.000	37.381
Moveable Ballst Box (FWD)	29.800	0.000	0.000	0.000	5.800	1.120	0.000	172.840	33.376	0.000	4.000	8.580	1002.472	0.000	37.381
Deck Covering	90.000	6.560	1.400	0.019	3.530	1.029	0.000	317.700	92.610	0.000	322.755	14.703	1121.481	0.000	95.296
								0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Moveable Ballast # 1	200.000	0.405	0.205	0.252	4.491	1.160	-0.457	898.200	232.000	-91.440	3.792	1.759	4033.816	41.806	269.120
Moveable Ballast # 2	200.000	0.405	0.205	0.252	4.910	1.160	-0.457	982.000	232.000	-91.440	3.792	1.759	4821.620	41.806	269.120
Moveable Ballast # 3	200.000	0.405	0.205	0.252	5.590	1.160	0.457	1118.000	232.000	91.440	3.792	1.759	6249.620	41.806	269.120
Moveable Ballast # 4	200.000	0.405	0.205	0.252	6.000	1.160	0.457	1200.000	232.000	91.440	3.792	1.759	7200.000	41.806	269.120
								0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
								0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
								0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Steel Ballast # 1	110.000	0.457	0.305	0.076	3.689	0.083	0.000	405.790	9.081	0.000	1.969	0.905	1496.959	0.000	0.750
Steel Ballast # 2	110.000	0.457	0.305	0.076	4.746	0.083	0.000	522.104	9.081	0.000	1.969	0.905	2478.114	0.000	0.750
Steel Ballast # 3	110.000	0.457	0.305	0.076	5.254	0.083	0.000	577.896	9.081	0.000	1.969	0.905	3036.034	0.000	0.750
Steel Ballast # 4	110.000	0.457	0.305	0.076	5.714	0.083	0.000	628.540	9.081	0.000	1.969	0.905	3591.478	0.000	0.750
								0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
								0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
								0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Steel Ballast # 5	110.000	0.457	0.305	0.076	3.689	0.162	0.000	405.790	17.815	0.000	1.969	0.905	1496.959	0.000	2.885
Steel Ballast # 6	110.000	0.457	0.305	0.076	4.746	0.162	0.000	522.104	17.815	0.000	1.969	0.905	2478.114	0.000	2.885
Steel Ballast # 7	110.000	0.457	0.305	0.076	5.254	0.162	0.000	577.896	17.815	0.000	1.969	0.905	3036.034	0.000	2.885
Steel Ballast # 8	110.000	0.457	0.305	0.076	5.714	0.162	0.000	628.540	17.815	0.000	1.969	0.905	3591.478	0.000	2.885
								0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
								0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Below Deck Ballast # 1	220.000	0.405	0.205	0.252	9.220	0.128	0.181	2028.400	28.160	39.820	4.171	1.935	18701.848	7.207	3.604
Below Deck Ballast # 2	220.000	0.405	0.205	0.252	9.220	0.128	-0.181	2028.400	28.160	-39.820	4.171	1.935	18701.848	7.207	3.604
Below Deck Ballast # 3	200.000	0.405	0.205	0.252	6.492	0.147	0.388	1298.320	29.400	77.600	3.792	1.759	8428.174	30.109	4.322
Below Deck Ballast # 4	200.000	0.405	0.205	0.252	6.492	0.147	-0.388	1298.320	29.400	-77.600	3.792	1.759	8428.174	30.109	4.322
Below Deck Ballast # 5 (Kid)	118.500	0.000	0.000	0.000	6.080	0.095	0.442	720.480	11.258	52.377	2.000	0.666	4380.518	23.151	1.069
Below Deck Ballast # 6 (Kid)	118.500	0.000	0.000	0.000	6.080	0.095	-0.442	720.480	11.258	-52.377	2.000	0.666	4380.518	23.151	1.069
Upper Deck Ballast # 1 (Kid)	119.660	0.000	0.000	0.000	0.207	1.070	0.514	24.770	128.036	61.505	0.666	2.000	5.127	31.614	136.999
Upper Deck Ballast # 2 (Kid)	119.660	0.000	0.000	0.000	0.207	1.070	-0.514	24.770	128.036	-61.505	0.666	2.000	5.127	31.614	136.999
Upper Deck Ballast # 3	25.890	0.505	0.100	0.080	0.602	1.060	0.770	15.586	27.443	19.935	0.564	0.035	9.383	15.350	29.090
Upper Deck Ballast # 4	25.890	0.505	0.100	0.080	1.110	1.060	0.770	28.738	27.443	19.935	0.564	0.035	31.899	15.350	29.090

IMD500 Ballast Plan
Ballast Condition

Upper Deck Ballast # 5	25.890	0.505	0.100	0.080	1.618	1.060	0.770	41.890	27.443	19.935	0.564	0.035	67.778	15.350	29.090
Upper Deck Ballast # 6	25.890	0.505	0.100	0.080	2.127	1.060	0.770	55.068	27.443	19.935	0.564	0.035	117.130	15.350	29.090
Upper Deck Ballast # 7	25.890	0.505	0.100	0.080	2.635	1.060	0.770	68.220	27.443	19.935	0.564	0.035	179.760	15.350	29.090
Upper Deck Ballast # 8	25.890	0.505	0.100	0.080	3.143	1.060	0.770	81.372	27.443	19.935	0.564	0.035	255.753	15.350	29.090
Upper Deck Ballast # 9	25.890	0.505	0.100	0.080	3.651	1.060	0.770	94.524	27.443	19.935	0.564	0.035	345.109	15.350	29.090
Upper Deck Ballast # 10	25.890	0.505	0.100	0.080	0.602	1.060	-0.770	15.586	27.443	-19.935	0.564	0.035	9.383	15.350	29.090
Upper Deck Ballast # 11	25.890	0.505	0.100	0.080	1.110	1.060	-0.770	28.738	27.443	-19.935	0.564	0.035	31.899	15.350	29.090
Upper Deck Ballast # 12	25.890	0.505	0.100	0.080	1.618	1.060	-0.770	41.890	27.443	-19.935	0.564	0.035	67.778	15.350	29.090
Upper Deck Ballast # 13	25.890	0.505	0.100	0.080	2.127	1.060	-0.770	55.068	27.443	-19.935	0.564	0.035	117.130	15.350	29.090
Upper Deck Ballast # 14	25.890	0.505	0.100	0.080	2.635	1.060	-0.770	68.220	27.443	-19.935	0.564	0.035	179.760	15.350	29.090
Upper Deck Ballast # 15	25.890	0.505	0.100	0.080	3.143	1.060	-0.770	81.372	27.443	-19.935	0.564	0.035	255.753	15.350	29.090
Upper Deck Ballast # 16	25.890	0.505	0.100	0.080	3.651	1.060	-0.770	94.524	27.443	-19.935	0.564	0.035	345.109	15.350	29.090
Upper Deck Ballast # 17	25.890	0.505	0.100	0.080	0.602	1.060	0.670	15.586	27.443	17.346	0.564	0.035	9.383	11.622	29.090
Upper Deck Ballast # 18	25.890	0.505	0.100	0.080	1.110	1.060	0.670	28.738	27.443	17.346	0.564	0.035	31.899	11.622	29.090
Upper Deck Ballast # 19	25.890	0.505	0.100	0.080	1.618	1.060	0.670	41.890	27.443	17.346	0.564	0.035	67.778	11.622	29.090
Upper Deck Ballast # 20	25.890	0.505	0.100	0.080	2.127	1.060	0.670	55.068	27.443	17.346	0.564	0.035	117.130	11.622	29.090
Upper Deck Ballast # 21	25.890	0.505	0.100	0.080	2.635	1.060	0.670	68.220	27.443	17.346	0.564	0.035	179.760	11.622	29.090
Upper Deck Ballast # 22	25.890	0.505	0.100	0.080	3.143	1.060	0.670	81.372	27.443	17.346	0.564	0.035	255.753	11.622	29.090
Upper Deck Ballast # 23	25.890	0.505	0.100	0.080	3.651	1.060	0.670	94.524	27.443	17.346	0.564	0.035	345.109	11.622	29.090
Upper Deck Ballast # 24	25.890	0.505	0.100	0.080	0.602	1.060	-0.670	15.586	27.443	-17.346	0.564	0.035	9.383	11.622	29.090
Upper Deck Ballast # 25	25.890	0.505	0.100	0.080	1.110	1.060	-0.670	28.738	27.443	-17.346	0.564	0.035	31.899	11.622	29.090
Upper Deck Ballast # 26	25.890	0.505	0.100	0.080	1.618	1.060	-0.670	41.890	27.443	-17.346	0.564	0.035	67.778	11.622	29.090
Upper Deck Ballast # 27	25.890	0.505	0.100	0.080	2.127	1.060	-0.670	55.068	27.443	-17.346	0.564	0.035	117.130	11.622	29.090
Upper Deck Ballast # 28	25.890	0.505	0.100	0.080	2.635	1.060	-0.670	68.220	27.443	-17.346	0.564	0.035	179.760	11.622	29.090
Upper Deck Ballast # 29	25.890	0.505	0.100	0.080	3.143	1.060	-0.670	81.372	27.443	-17.346	0.564	0.035	255.753	11.622	29.090
Upper Deck Ballast # 30	25.890	0.505	0.100	0.080	3.651	1.060	-0.670	94.524	27.443	-17.346	0.564	0.035	345.109	11.622	29.090
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Upper Deck Ballast # 31 (Kid)	118.000	0.000	0.000	0.000	6.506	1.173	0.000	767.708	138.414	0.000	0.666	2.000	4994.708	0.000	162.360
Upper Deck Ballast # 32 (Kid)	118.000	0.000	0.000	0.000	6.438	1.173	0.514	759.660	138.414	60.652	0.666	2.000	4890.542	31.175	162.360
Upper Deck Ballast # 33 (Kid)	118.000	0.000	0.000	0.000	6.438	1.173	-0.514	759.660	138.414	-60.652	0.666	2.000	4890.542	31.175	162.360
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Upper Deck Ballast # 34	20.000	0.405	0.205	0.252	0.207	1.090	0.073	4.140	21.800	1.460	0.379	0.176	0.857	0.107	23.762
Upper Deck Ballast # 35	20.000	0.405	0.205	0.252	0.207	1.090	-0.073	4.140	21.800	-1.460	0.379	0.176	0.857	0.107	23.762
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	5646.240	Kg							3697.039	0.000	10529.754	457.198	164302.144	791.561	3530.568

	Actual		Target	
DISPLACEMENT=	5646.24	Kg	5637.87	Kg
LCG=	4.959		4.968	m
VCG=	0.655		0.652	m
TCG=	0.000		0.000	m
Radius of Gyration (pitch)=	2.563		2.500	m
Radius of Gyration (roll)=	0.646		0.660	m

Mass momment of Inertia (pitch)= 37095.691 Kgm^2

Mass momment of Inertia (Roll)= 2358.584 Kgm^2

Appendix 3 TEMPSC Drawings, Hydrostatics and Mass Properties

LIFEBOAT
Full Scale Metres

Hydrostatic Properties

Draft is from Baseline
Trim: aft 0.78 deg., No heel, VCG = 1.370

LCF Draft (m)	Displ (MT)	LCB (m)	VCB (m)	LCF (m)	TPcm (MT/cm)	MTcm (MT-m /deg)	GML (m)	GM(Solid) (m)
0.840	11.007	0.111a	0.581	0.143a	0.25	2.29	11.916	0.707

Water Specific Gravity = 1.025 kg/L.

Hull Data (with appendages)

Baseline Draft: 0.838 at Origin
Trim: aft 0.78 deg.
Heel: zero

DIMENSIONS
Length Overall: 9.800 m LWL: 9.775 m Beam: 3.300 m BWL: 3.184 m
Volume: 10.738 m^3 Displacement: 11.007 MT

COEFFICIENTS
Prismatic: 0.693 Block: 0.384 Midship: 0.555 Waterplane: 0.779

RATIOS
Length/Beam: 2.970 Displacement/length: 328.428 Beam/Depth: 3.675
MT/ cm Immersion: 0.248

AREAS
Waterplane: 24.233 m^2 Wetted Surface: 31.429 m^2
Under Water Lateral Plane: 7.356 m^2 Above Water Lateral Plane: 6.617 m^2

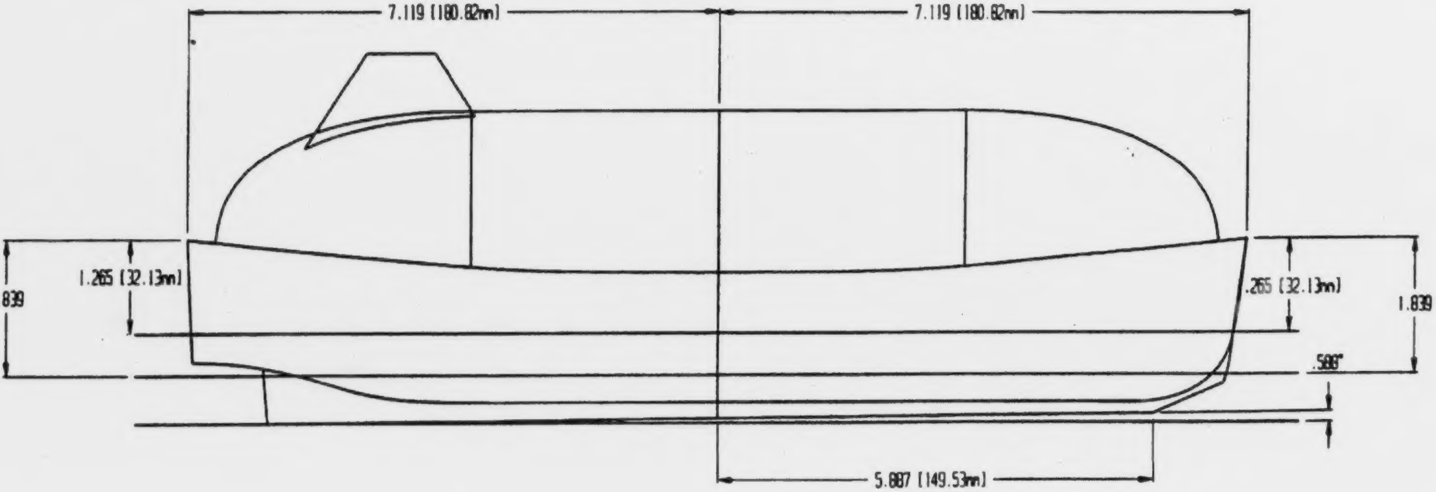
CENTROIDS (Meters)
Buoyancy: LCB = 0.111 aft TCB =0.000 stbd VCB = 0.581
Flotation: LCF = 0.143 aft
Under Water LP: 0.192 aft of Origin, 0.388 below waterline.
Above Water LP: 0.102 aft of Origin, 0.346 above waterline.

Note: Coefficients calculated based on true waterline length of 09.775 m

Wednesday, April 04, 2001 16:18:29

Notes:

Deburr - Remove All Sharp Edges

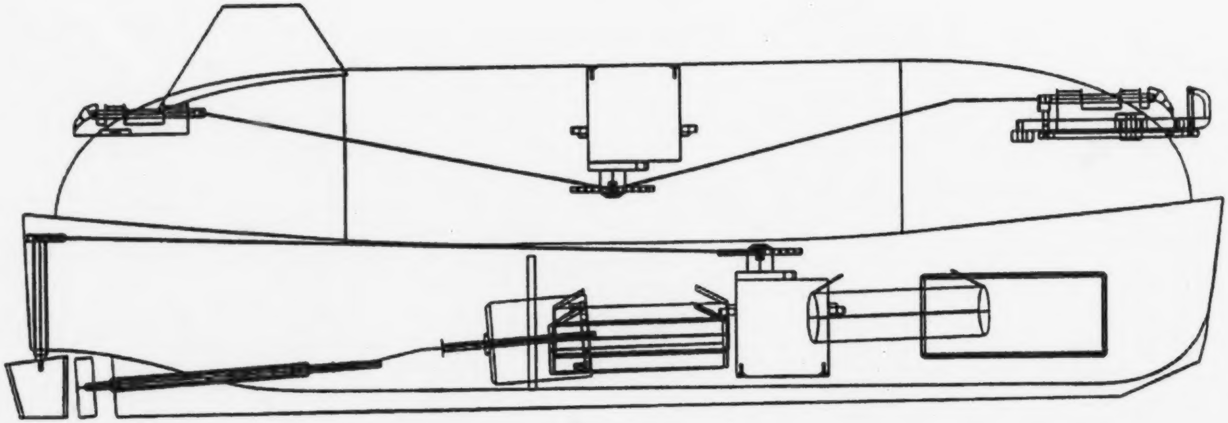


National Research Council Canada
Conseil national de recherches Canada
NRC-CNRC

TOLERANCES
(unless specified)
0.X ± 0.03
0.XX ± 0.015
0.XXX ± 0.005
Angle +/- .5 deg.
Fabrication +/- .04

Institute for Marine Dynamics
Kervin Place, P.O. Box 12093, Postal Station A
St. John's, Newfoundland A1B 3T5

913
T. Hall
Waterline & Hydrostatic Release Height
A3
913A06
Quantity 1
11-Jan-2001



National Research Council Canada
Conseil national de recherches Canada
NRC·CNRC

TOLERANCES
(unless specified)
0.X ± 0.03
0.XX ± 0.015
0.XXX ± 0.005
Angle +/- .5 deg.
Fabrication +/- .04

Material

Heat treatment

Institute for Marine Dynamics

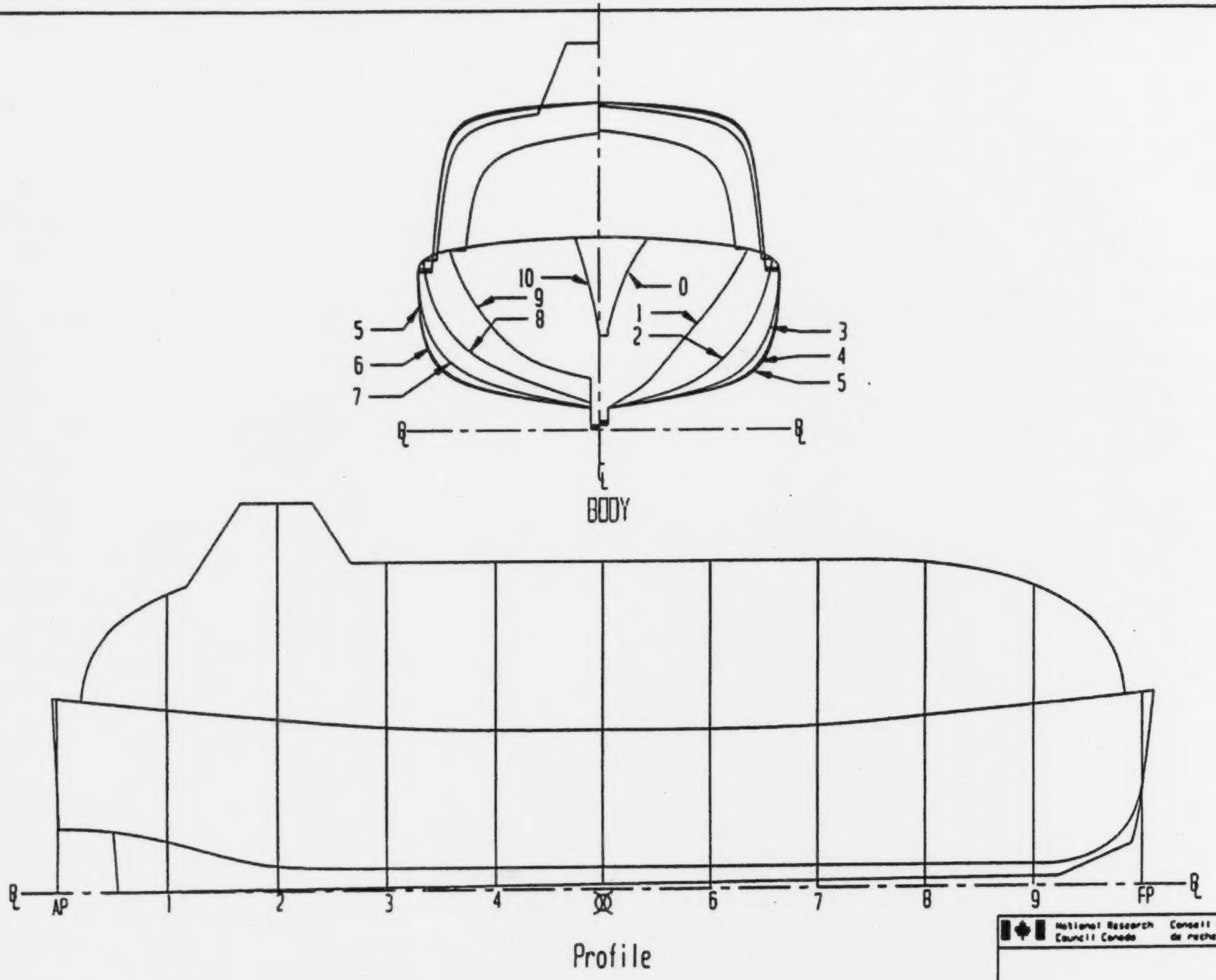
Kerwin Place, P.O. Box 12093, Postal Station A
St. John's, Newfoundland A1B 3T5

913

General Arrangement
Centreline Profile of TEMPSC

A3

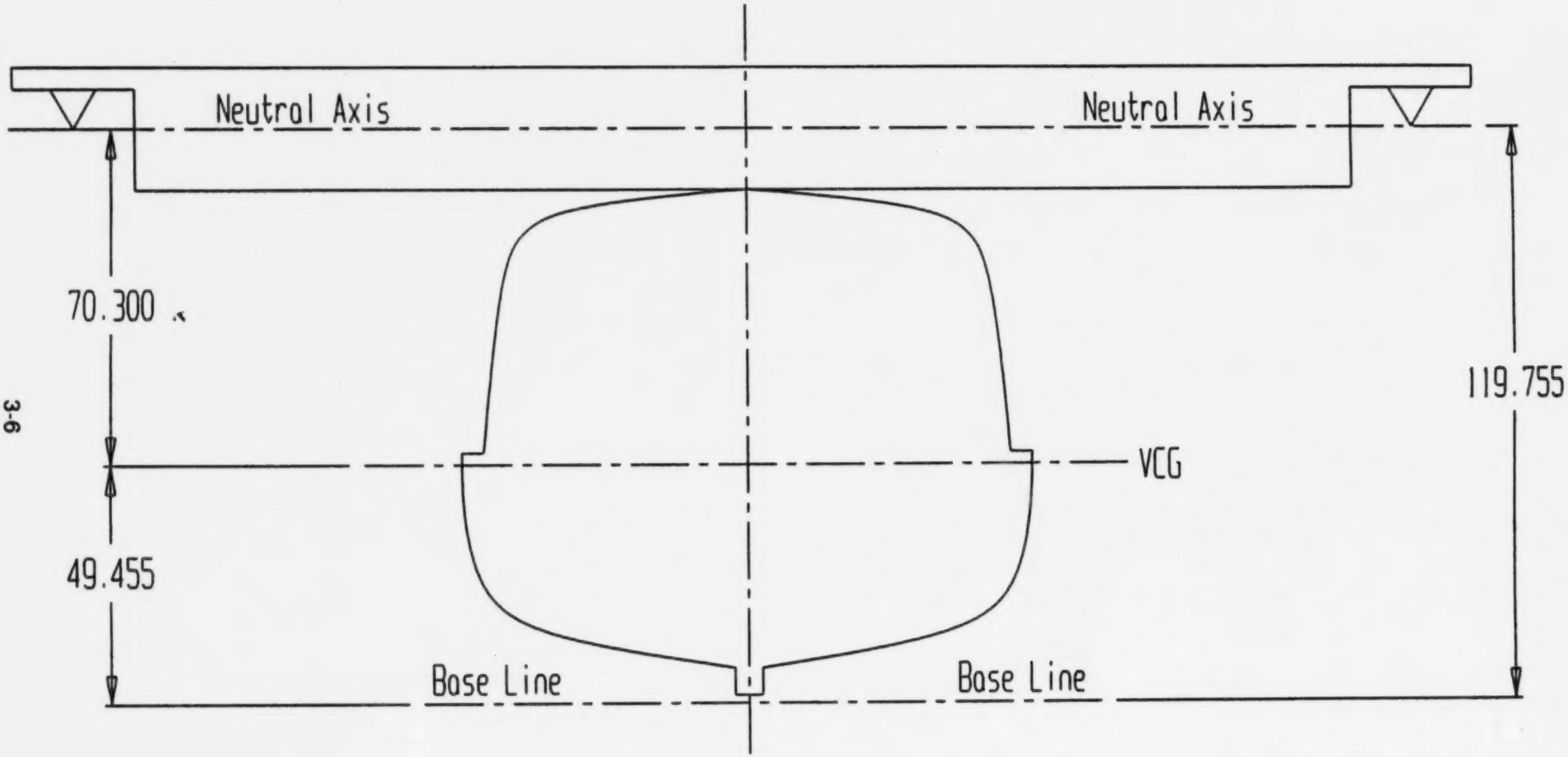
Quantity 1



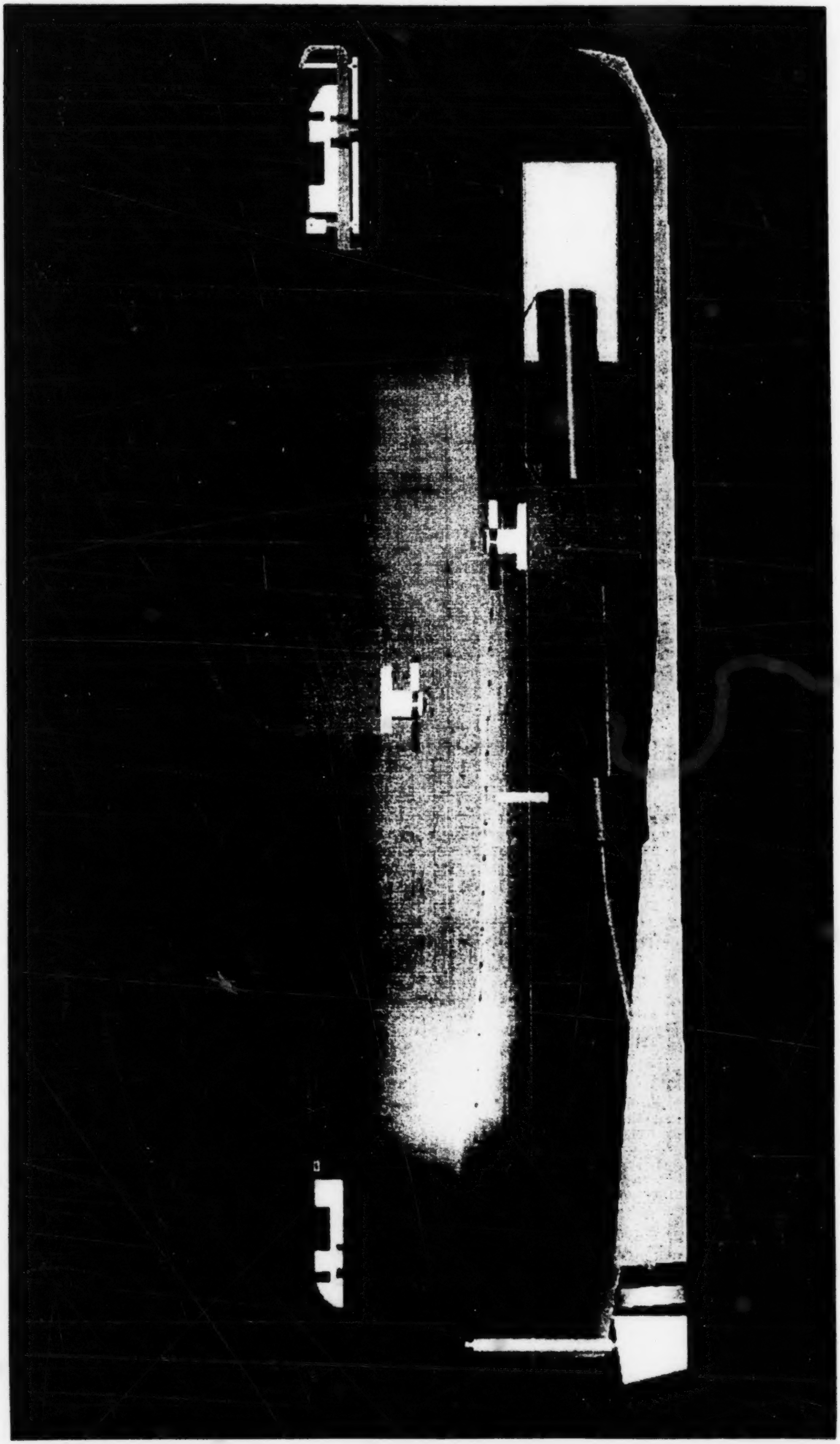
National Research Council Canada Conseil national de recherches Canada NRC-CNRC

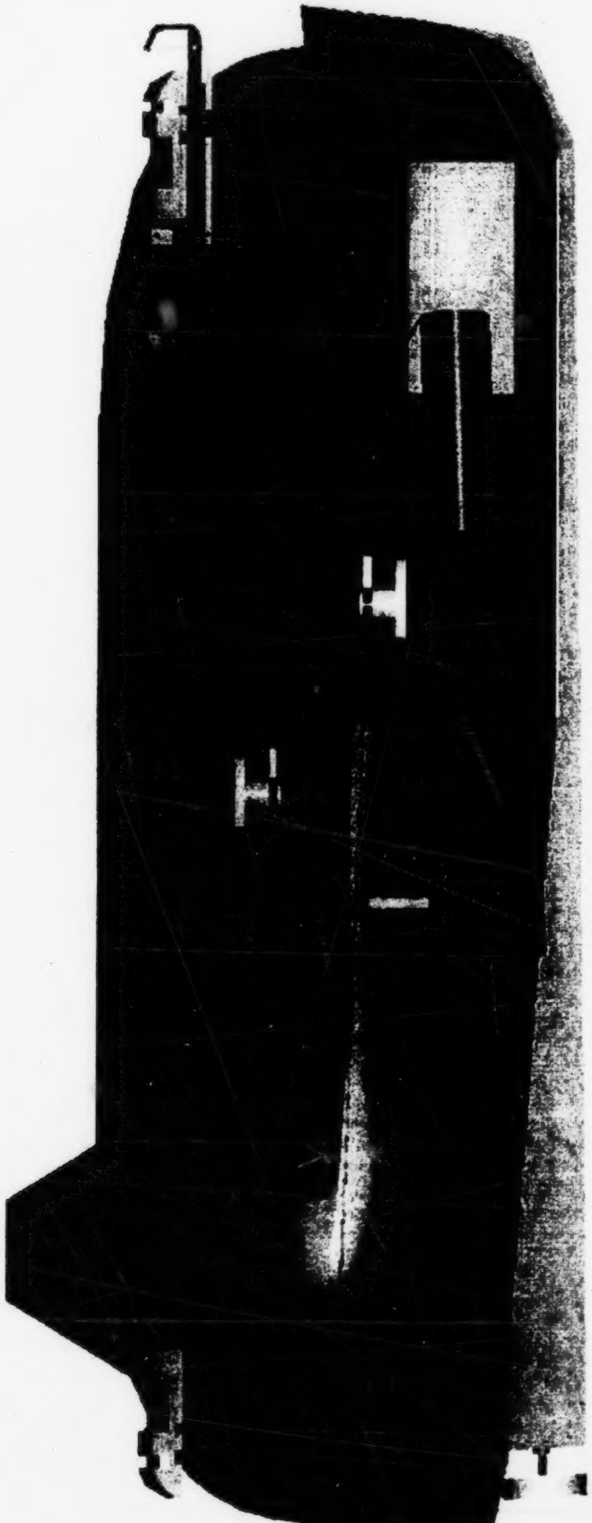
Hull lines for the TEMPSC

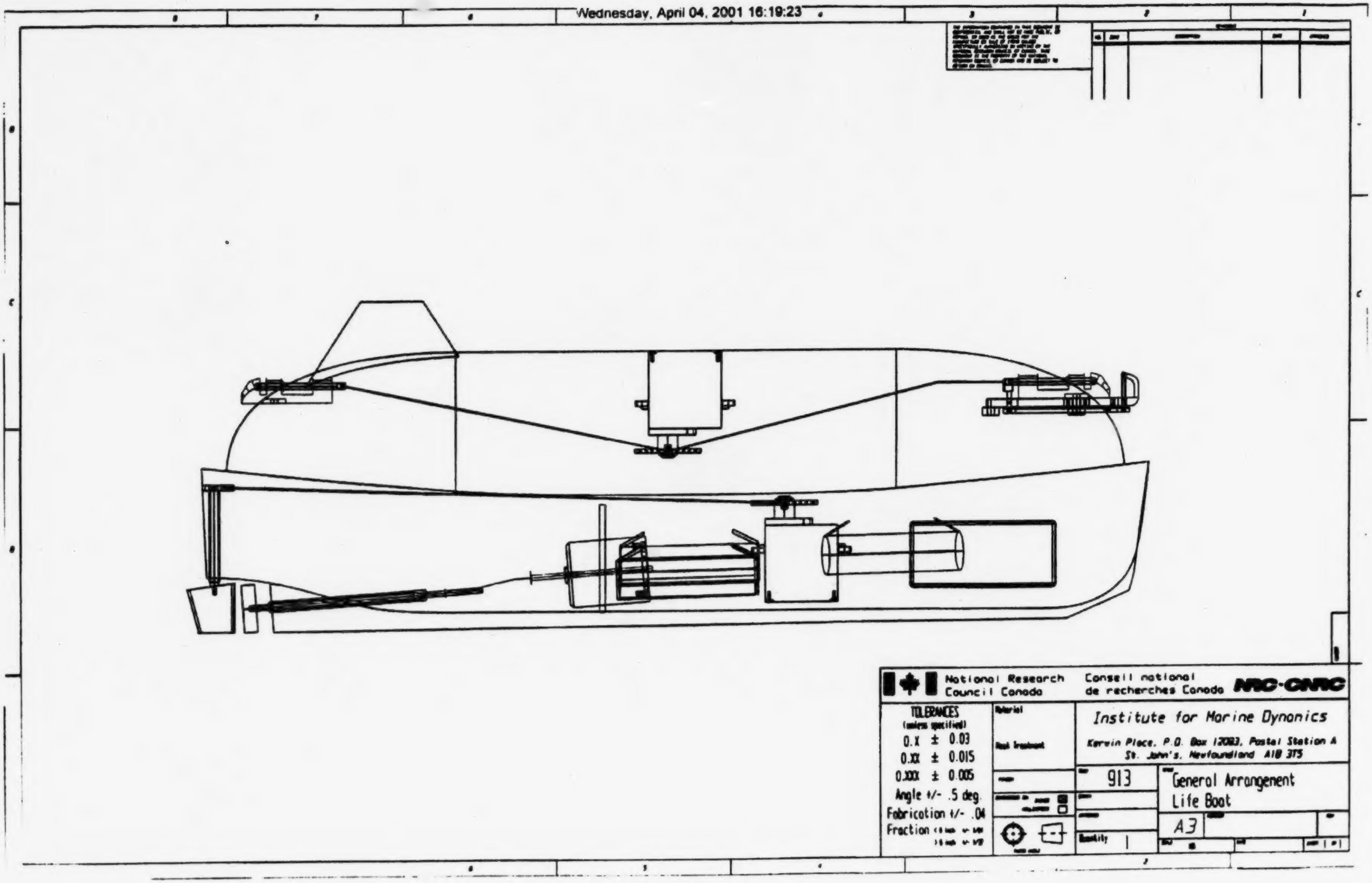
Life Boat Swing Results



Dimensions are in model scale mm






Wednesday, April 04, 2001 16:19:23
National Research Council Canada
Conseil national de recherches Canada
NRC·CNRC
TOLERANCES (unless specified)
0.X ± 0.03
0.XX ± 0.015
0.XXX ± 0.005
Angle +/- .5 deg.
Fabrication +/- .04
Fraction
Material
Heat Treatment
Institute for Marine Dynamics
Kerwin Place, P.O. Box 12093, Postal Station A
St. John's, Newfoundland A1B 3T5
913
General Arrangement
Life Boat
A3
Quantity 1

Propulsion steering and release mechanisms

Propulsion and rudder control systems

Propulsion and rudder control was accomplished by the use of a Futaba digital proportional radio control system. The Futaba model number PCM1024 is an 8 channel PPM radio control system.

Channel 3 was used for motor speed control with JETI model JES04 speed controller. This channel was trimmed within the controller to limit maximum speed, a calibration was then carried out for each of the lifeboat models. The calibration consisted of multiple timed runs over a 20-meter distance. A set point was established on the controller to achieve the required speed for each model.

FPSO Lifeboat #1 Speed cal.

t(s) @20m	m/s
24.44	0.818330606
21.98	0.909918107
29.34	0.681663258
34.43	0.58088876
31.31	0.638773555

Speed setting used

Channel 4 was used for rudder control. Prior to the speed calibration runs the rudder channel was trimmed. This adjustment ensured that each of the lifeboat models followed a straight heading when the controller joystick was at its 0 position. A second adjustment for this channel was to limit the rubber travel to the required range, the controller's programming function enabled this to be achieved also. Rubber control was now available via a joystick on the radio system.

Power for the controller and lifeboat models

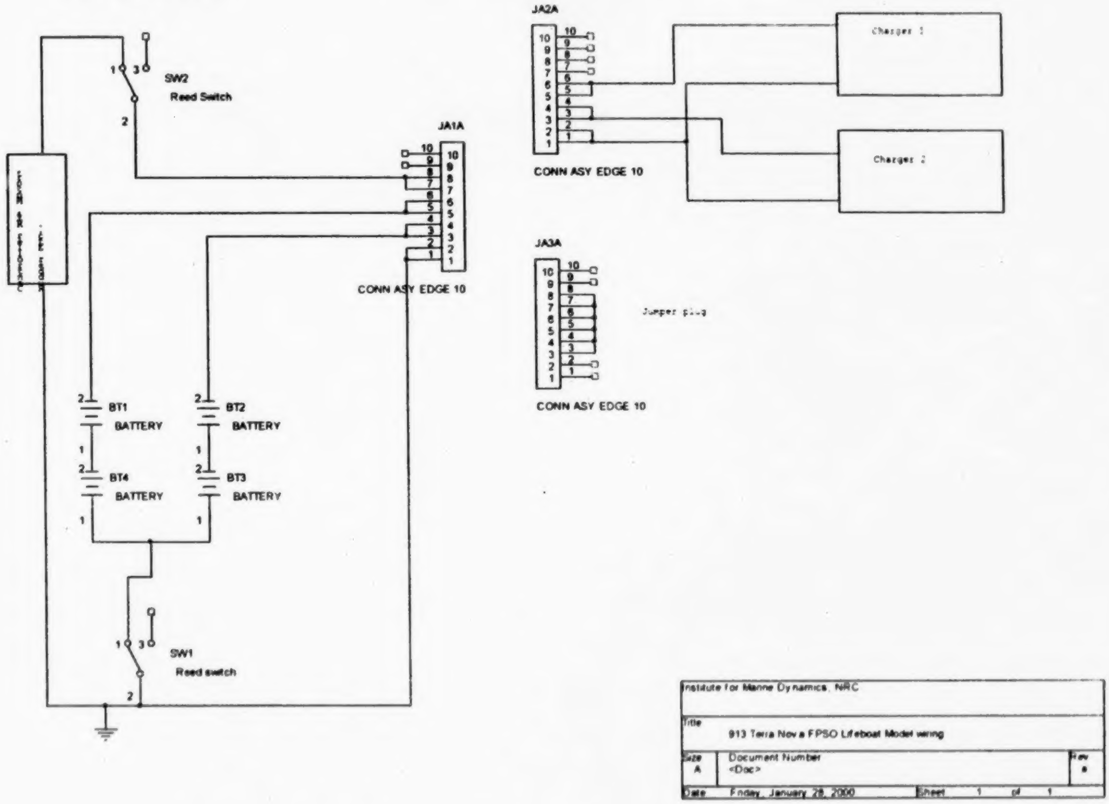
The digital proportional radio was modified so that it could be powered by a regulated lab supply, this ensured consistent function and removed any potential control errors as a result of its original battery powered systems becoming discharged during testing. Another benefit of this modification was to eliminate the need to continually recharge the controller, thus extending its functional time, otherwise it would have been limited to about three hours a day. The recharge time for the controller would have been 12 hours. This would have caused unacceptable limitations on testing.

Power for the lifeboat models was provided by four lithium metal AA rechargeable batteries (TLR-7103 Tadiran). This was the first use of this new battery technology at the Institute, the benefits over the previous NiCad based system were:

- An increase in energy density versus weight of 40 percent.
- Faster charge cycles, full charge was achieved in four hours, this was approximately 25 percent of time required to charge a equivalent NiCad power pack.
- The lithium metal battery technology doesn't have the memory charge problem that is associated with the NiCad technology.
- With a higher terminal voltage of 3 volts versus 1.2 volts, the four-cell lithium metal arrangement provided six volts nominal voltage with a 1600 milliamp hour rating.

Each lifeboat model's battery pack was wired to a small external connector, a low-profile shortening plug, when in place powered up the model. When the plug was removed the external connector was now available to charge the model's battery pack. This configuration allows each model to be recharged without disassembly, saving time, potential ballast changes and possibly compromising watertight integrity. (See Wiring diagram 1.)

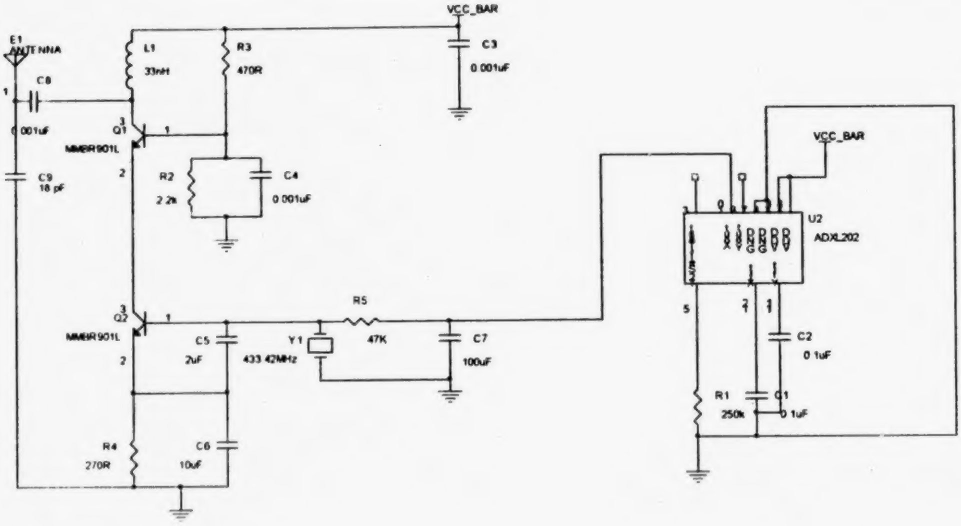
Wiring diagram 1.



Accelerometer and Digital Radio Transmitter

A +/- 2 *g* accelerometer was used in each model to monitor roll and side impact. Analog Devices part ADXL202 was configured for a 50 Hz bandwidth and operational frequency of 500Hz. (See Diagram 2.) This unit provides a digitally compatible output for the radio transmitter. The signal conditioning on the transmitted data is done at the shore side. The digital receiver output is filtered, this voltage is then monitored by main data collection system. The radio system used was the Ramsey's transmitter module TX-433 and receiver module RX-433, operating at 433MHz.

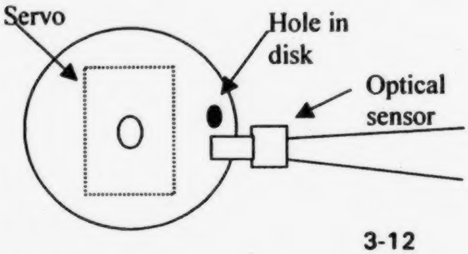
Wiring diagram 2.



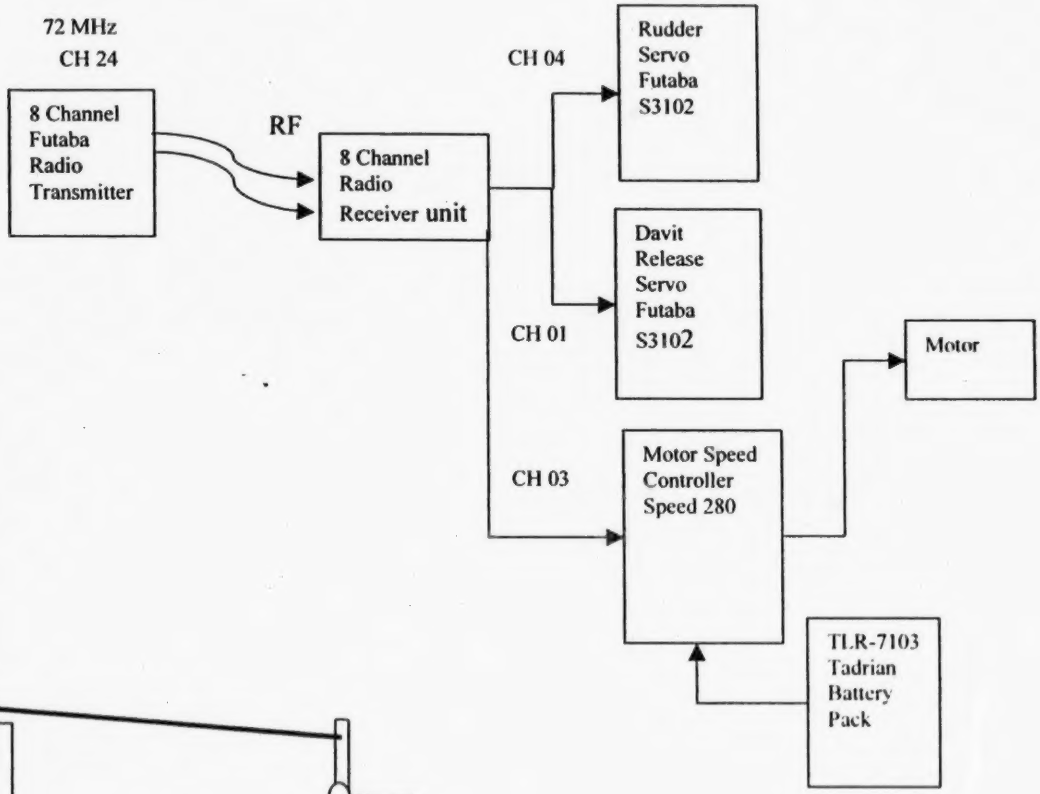
Institute for Marine Dynamics, NRC		
Title Terra Nova FPSO lifeboat Accelerometer / RF		
Size A	Document Number <Doc>	Rev 0
Date	Friday, January 28, 2000	Sheet 1 of 1

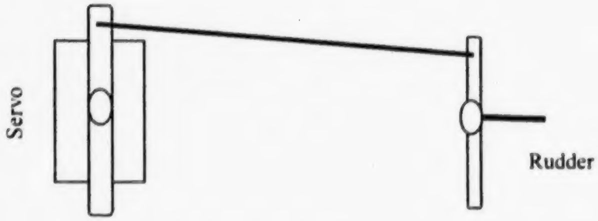
Release mechanisms

Bow, Stern and tag line release was controlled by channel 1 on the Futaba digitally proportional radio controller. A servo was mechanically fitted on each model to activate all three release mechanisms simultaneously. This channel was trimmed and its travel was limited so that all three release mechanisms were synchronised. This channel was controlled via the right side joystick, at its zero position all releases were held in their closed position. This channel was monitored using second received system on the shore side. A receiver using the same channel controlled a servo which activated a switch, both the model's davit release servo and this monitoring servo moved in unison, when the davit released the switch sent a voltage level to the data collection system.



Block Diagram


72 MHz
CH 24
8 Channel Futaba Radio Transmitter
RF
8 Channel Radio Receiver unit
CH 04
Rudder Servo Futaba S3102
Davit Release Servo Futaba S3102
CH 01
Motor
CH 03
Motor Speed Controller Speed 280
TLR-7103 Tadrian Battery Pack

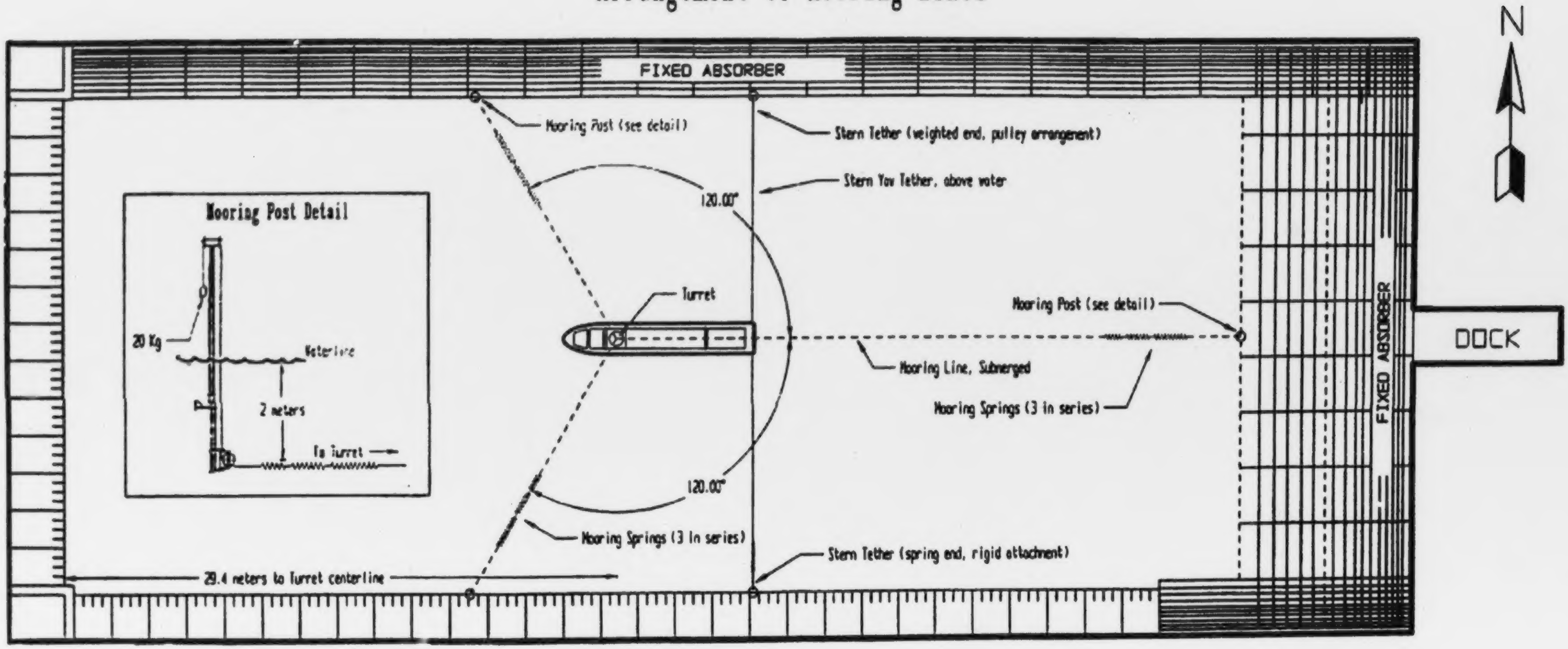


Rudder mechanism

Appendix 4 Horizontal Mooring Configuration

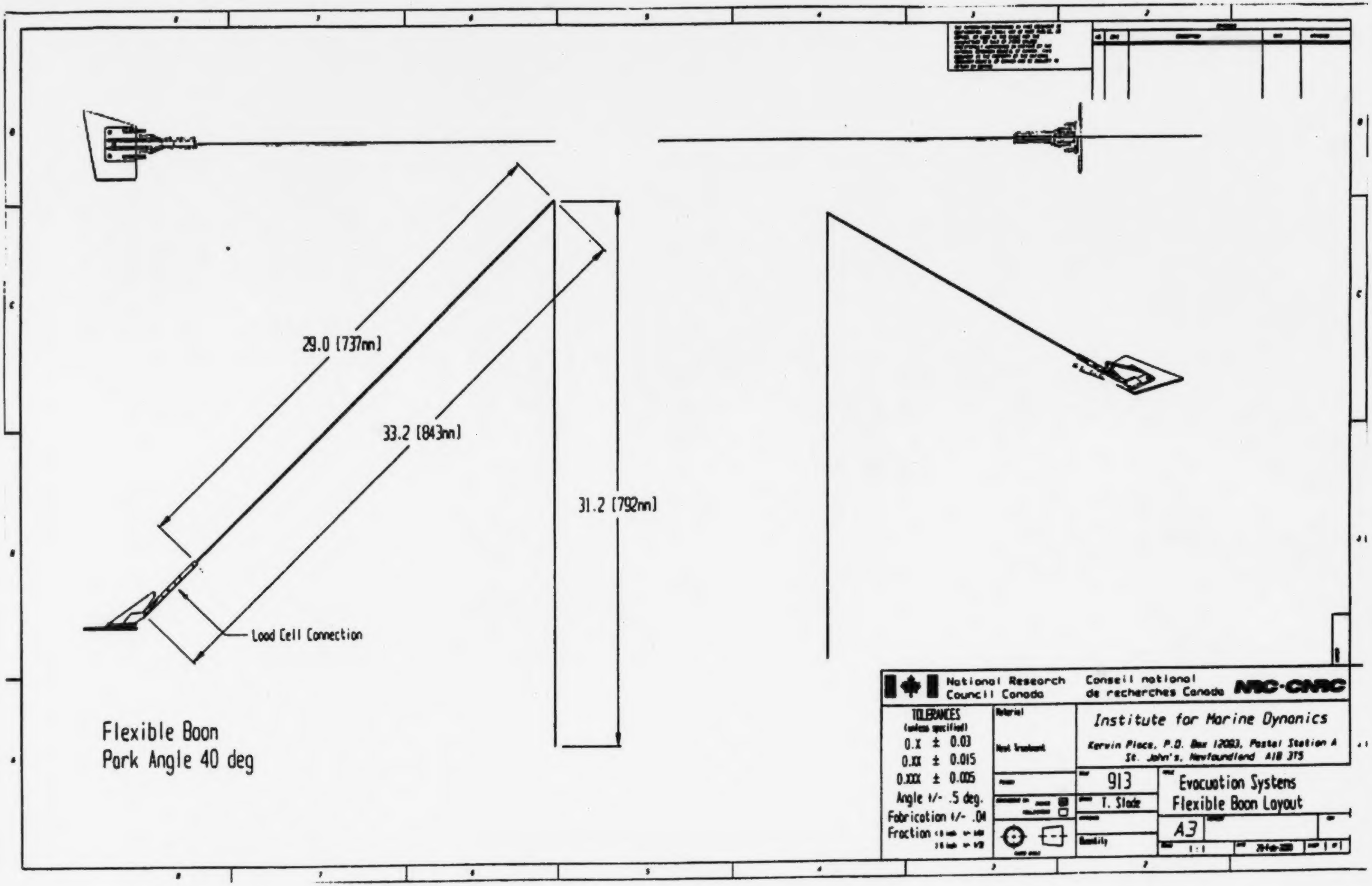
Location of the *FPSO Model* in the *OEB*

Arrangement of Mooring Lines



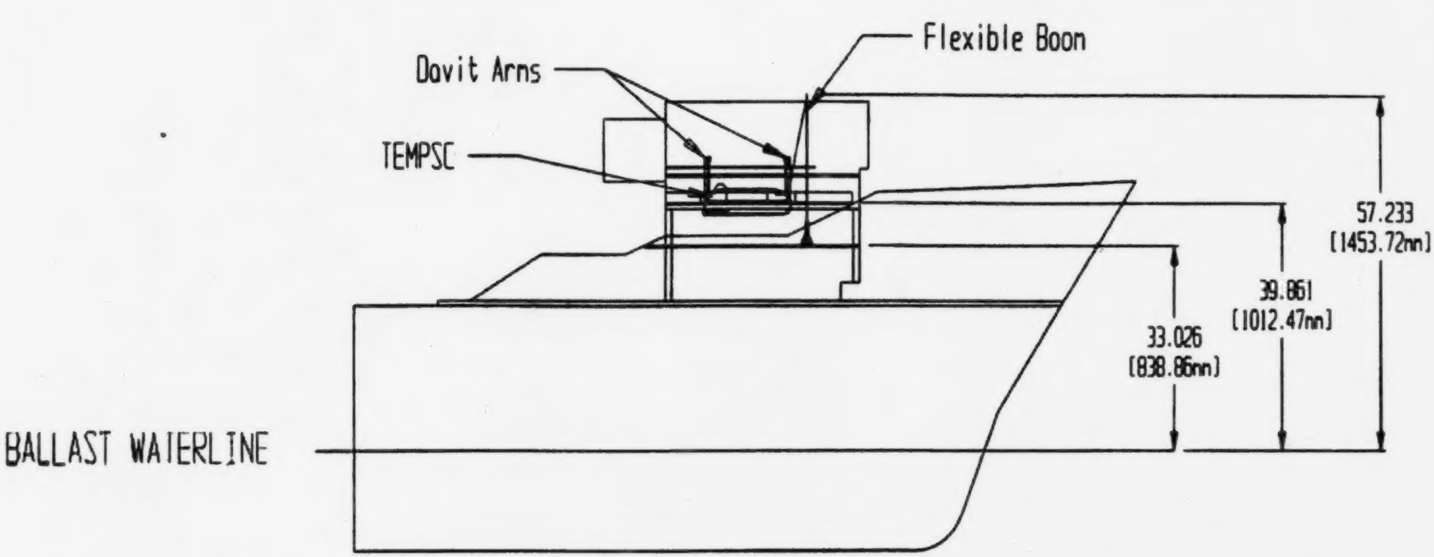
N
FIXED ABSORBER
Mooring Post (see detail)
Stern Tether (weighted end, pulley arrangement)
Stern Yaw Tether, above water
120.00°
Mooring Post Detail
20 Kg
Waterline
2 meters
To Turret
Turret
Mooring Post (see detail)
DOCK
FIXED ABSORBER
Mooring Line, Submerged
Mooring Springs (3 in series)
120.00°
Mooring Springs (3 in series)
Stern Tether (spring end, rigid attachment)
29.4 meters to Turret centerline

Appendix 5 Flexible Boom System and Associated Equipment

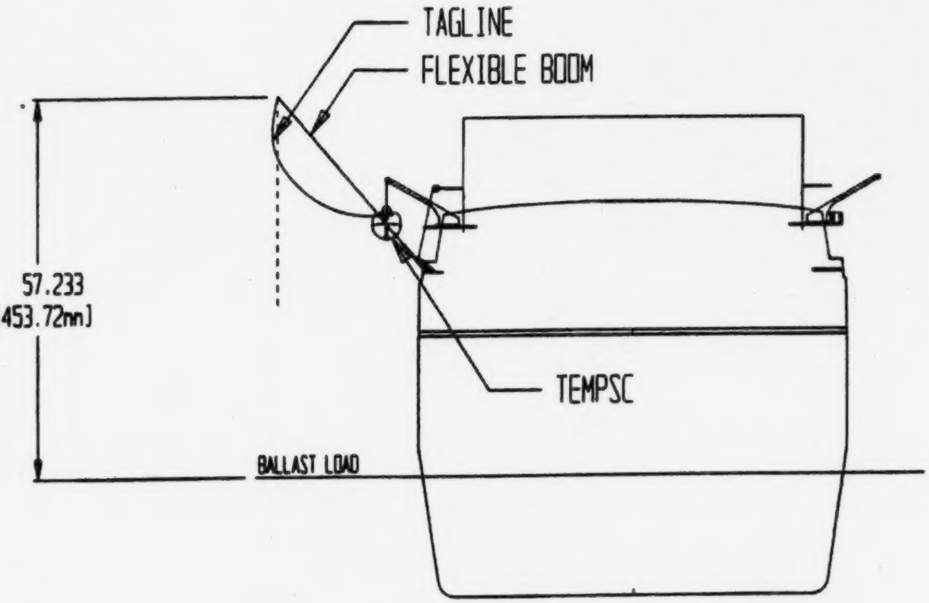

29.0 [737mm]
33.2 [843mm]
31.2 [792mm]
Load Cell Connection
Flexible Boon
Park Angle 40 deg
National Research Council Canada
Conseil national de recherches Canada
NRC·CNRC
TOLERANCES
(unless specified)
0.X ± 0.03
0.XX ± 0.015
0.XXX ± 0.005
Angle +/- .5 deg.
Fabrication +/- .04
Fraction
Material
Heat Treatment
Quantity
Institute for Marine Dynamics
Kervin Place, P.D. Box 12093, Postal Station A
St. John's, Newfoundland A1B 3T5
913
T. Slade
Evacuation Systems
Flexible Boon Layout
A3
1:1

Profile View of the FPSO Model, Forword End

Arrangenent of the TEMPSC, Dovit Arns, and Flexible Boon



BODY VIEW OF FPSO
INTACT CONDITION



0° HEEL
FORWARD LOOKING AFT

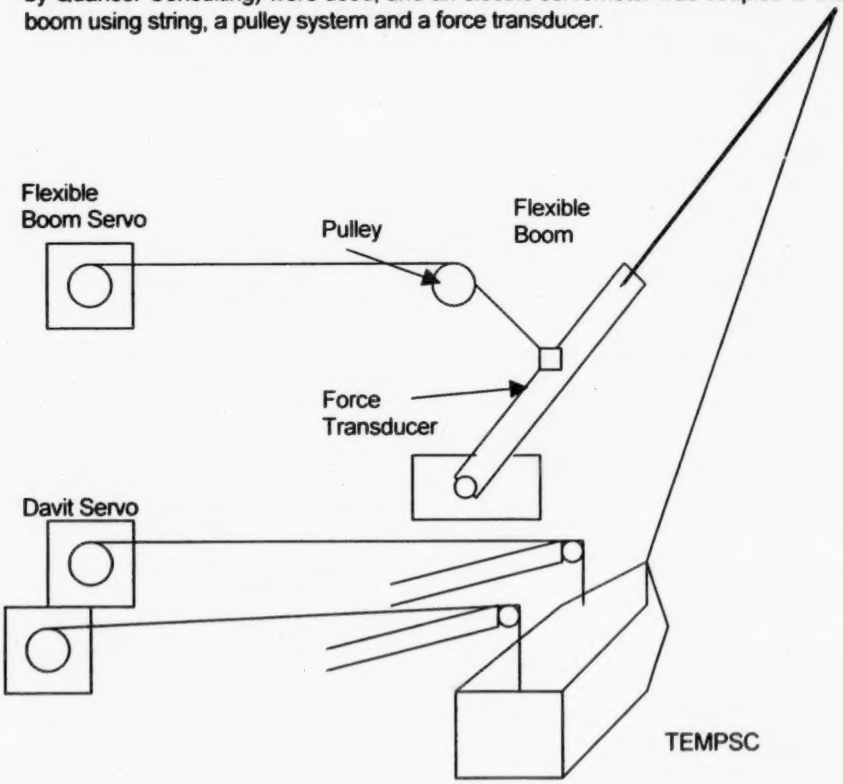
Flexible Boom Implementation for FPSO Evacuation System

Simulink Modeling of Flexible Boom with Real-Time Implementation Using Quanser WinCon

Prepared by: Lloyd Smith

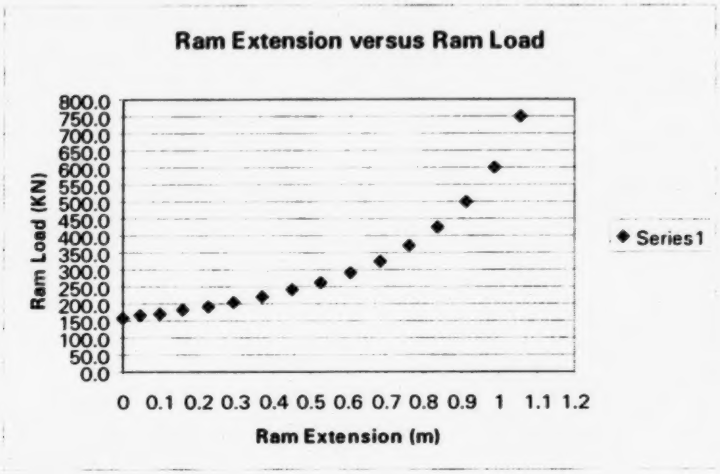
Introduction

A twin falls davit evacuation system enhanced with a flexible boom was installed on a floating production, storage and offloading (FPSO) vessel. This system consists of a 72-person totally enclosed motor propelled survival craft (TEMPSC) launched with a standard davit coupled with the flexible boom. The flexible boom adds stability to the TEMPSC as it is lowered and provides an extra push away from the FPSO upon reaching the water. The davit system with the flexible boom added was to be modeled by IMD/NRC to evaluate its performance on the FPSO under various environmental conditions. The model scale used was 27.65 to 1; this scale was selected for the optimal performance of the FPSO model. This scale made the physical realization of the boom's hydraulic ram at model size impractical. For this reason it was determined that the ram could be modeled and simulated using full-scale data of its physics. A simulation tool called Simulink (produced by The Math Works) and a real-time target compiler called WinCon (produced by Quanser Consulting) were used, and an electric servomotor was coupled to the flexible boom using string, a pulley system and a force transducer.



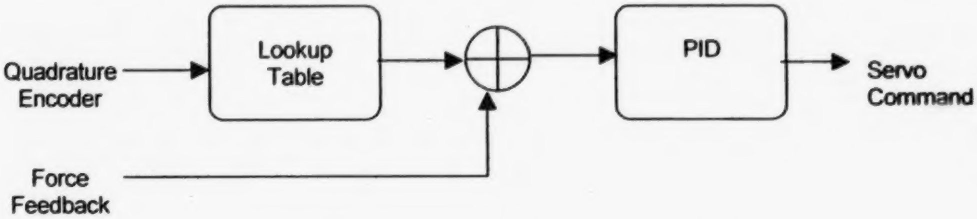
The Modeling of the Flexible Boom

Full-scale data was obtained from the manufacturer of a flexible boom system and was used to calculate model-scale characteristics for the system to be modeled using Simulink. The data consisted of a graph of force exerted by the hydraulic ram vs the ram's extension. The model used 27.65 scaling for ram extension and (27.65)^3 scaling for the force. The resulting model scale data was placed in a lookup table. This lookup table was used in a control loop in Simulink and allowed the servomotor to take on the exact model-scale characteristics of the boom's ram.



Cum. Ext. m	Ram Load Kg	Ram Force KN	Model Ext cm	Model Force N
0	16011.86	160.138	0	7.575476
0.045	16566.02	165.681	0.162749	7.837656
0.098	17269.98	172.721	0.354430	8.170709
0.159	18158.05	181.603	0.575045	8.590873
0.226	19245.03	192.474	0.817360	9.105141
0.297	20548.55	205.511	1.074141	9.721858
0.372	22132.07	221.348	1.345389	10.47105
0.449	24033.55	240.365	1.623870	11.37067
0.527	26324.59	263.278	1.905967	12.45460
0.606	29137.82	291.414	2.191682	13.78558
0.684	32574.94	325.789	2.473779	15.41174
0.762	36931.40	369.359	2.755877	17.47285
0.838	42464.88	424.701	3.030741	20.09083
0.913	49833.21	498.393	3.301989	23.57691
0.987	60127.12	601.345	3.569620	28.44713
1.058	74989.51	749.987	3.826401	35.47877

The control loop in Simulink uses a digital quadrature encoder on the servomotor as position feedback. This position (the ram's extension) is fed to the lookup table and results in a command of the desired force to be exerted by the ram. This command is compared to the actual force exerted by the servo via a force transducer mounted on the flexible boom at the location of the actual ram coupling. Using standard control theory the difference between the commanded force and actual force is fed through a Proportional Derivative Integral (PID) controller and tuned to make the system stable and have the transfer function of the actual flexible boom ram.



The Simulink model is then compiled into a real-time executable program via the Quanser WinCon tool, and run on a Pentium 200MHz Computer. The computer uses the Quanser MultiQ DAQ board to acquire the position feedback from the servomotor, the force feedback from the force transducer and provide the appropriate command to the servomotor.

Remarks

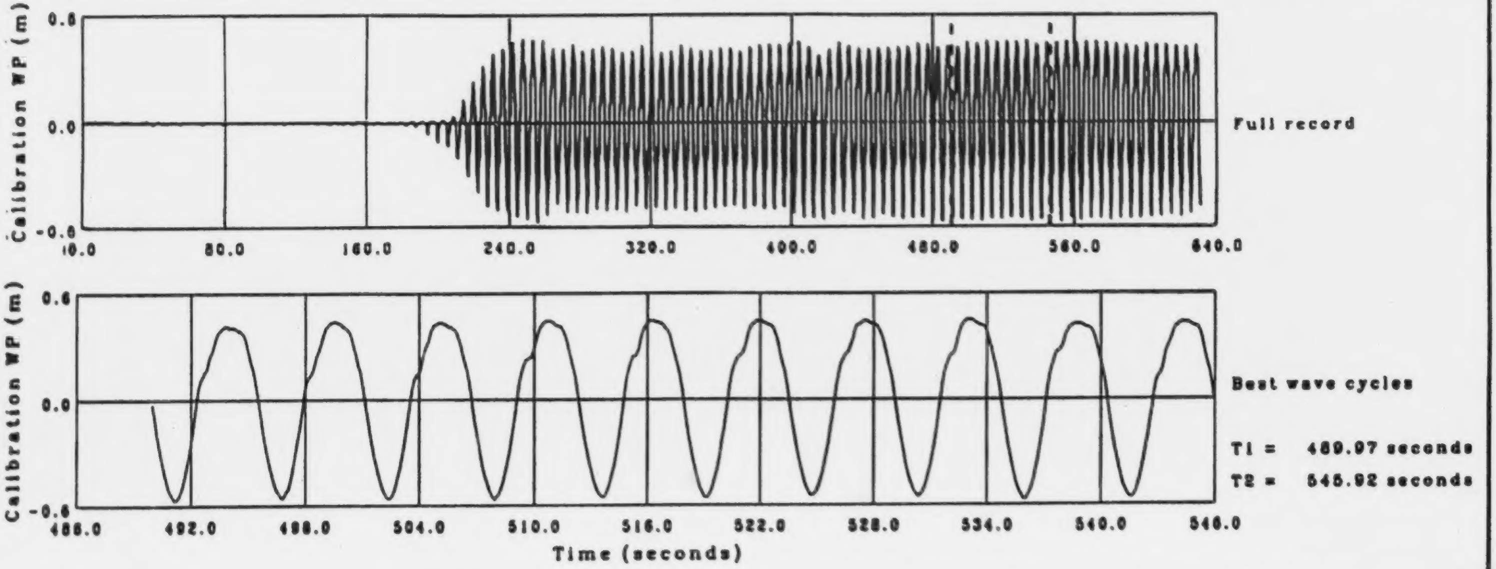
The resultant system closely models a flexible boom Hydraulic Ram and can be used to accurately simulate the functionality of the boom during model testing. The system behaves as defined by the physics obtained from manufacturers of flexible booms with possible sources of error limited to friction of the pulley system, force transducer drift (both of which are negligible) and inaccuracies in the data provided by the manufacturers themselves.

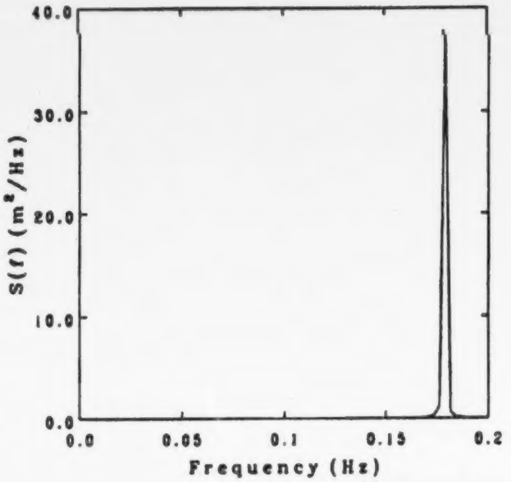
Appendix 6 Environmental Calibrations

Offshore Evacuation Systems Performance
Regular Wave Calib

NRC-IMD

Analyzed: 01-FEB-2001 17:06:57
Acquired: 16-DEC-1999 16:07:06





		Target / (Tolerance):
Full record wave parameters:		
Average wave height	= 0.95 m	
Average wave period	= 5.60 seconds	
Best wave cycles parameters:		
Average wave height	= 1.00 m	1.01 m
Average wave period	= 5.60 seconds	5.60 seconds
Deviation from target height	= 0.59 %	(5.0 %)
Wave height stability	= 3.31 %	(5.0 %)
Wave crest stability	= 2.04 %	(2.5 %)

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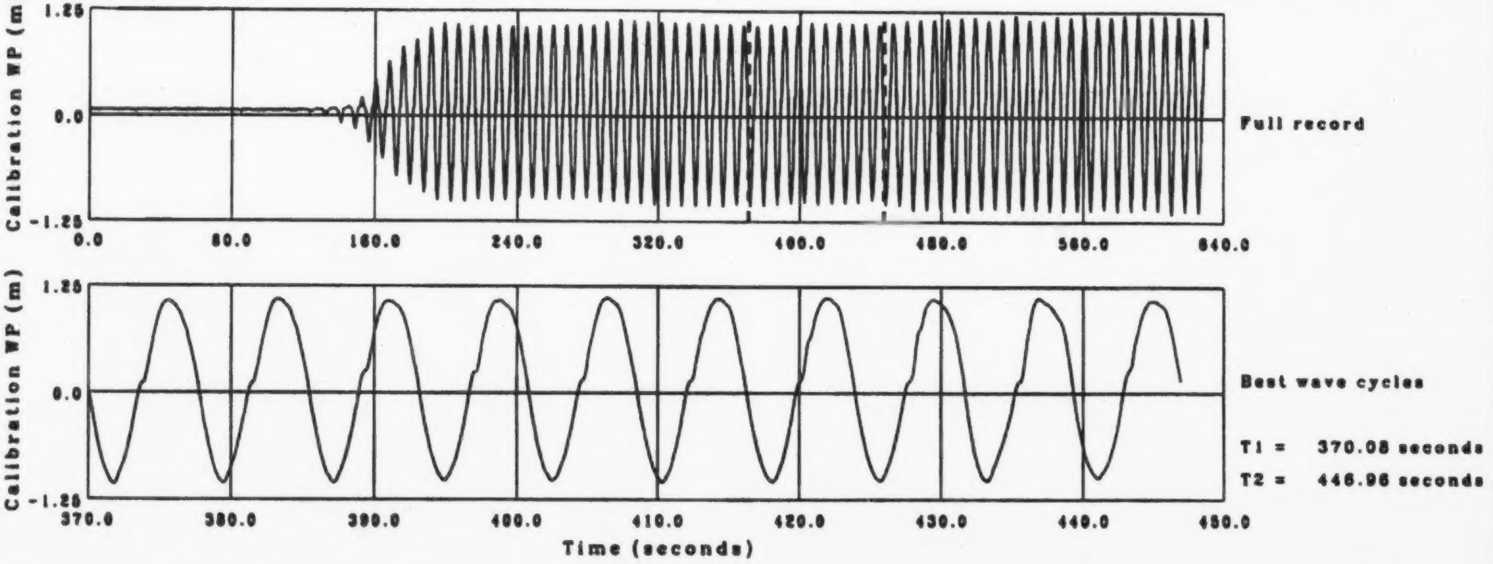
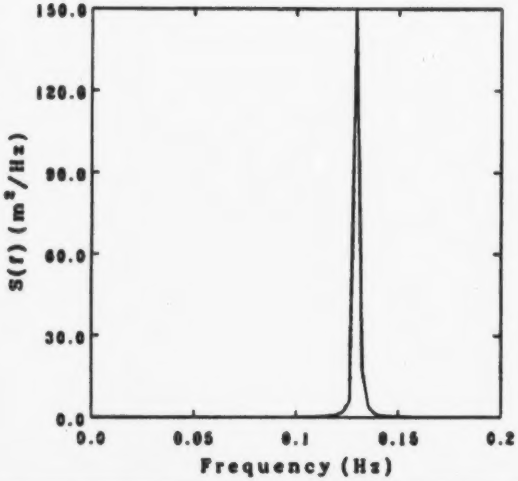
GENERATED BY:	CHECKED BY:	APPROVED BY:

Figure A2 REG_H1P01_T5P6_001

Offshore Evacuation Systems Performance
Regular Wave Calib NRC-IMD

Analyzed: 06-FEB-2001 12:05:13
Acquired: 17-DEC-1999 09:18:20





Full record wave parameters:		
Average wave height	= 2.18 m	
Average wave period	= 7.70 seconds	
		Target /
Best wave cycles parameters:		(Tolerance):
Average wave height	= 2.14 m	2.10 m
Average wave period	= 7.71 seconds	7.70 seconds
Deviation from target height	= 1.79 %	(5.0 %)
Wave height stability	= 2.34 %	(5.0 %)
Wave crest stability	= 1.39 %	(2.5 %)

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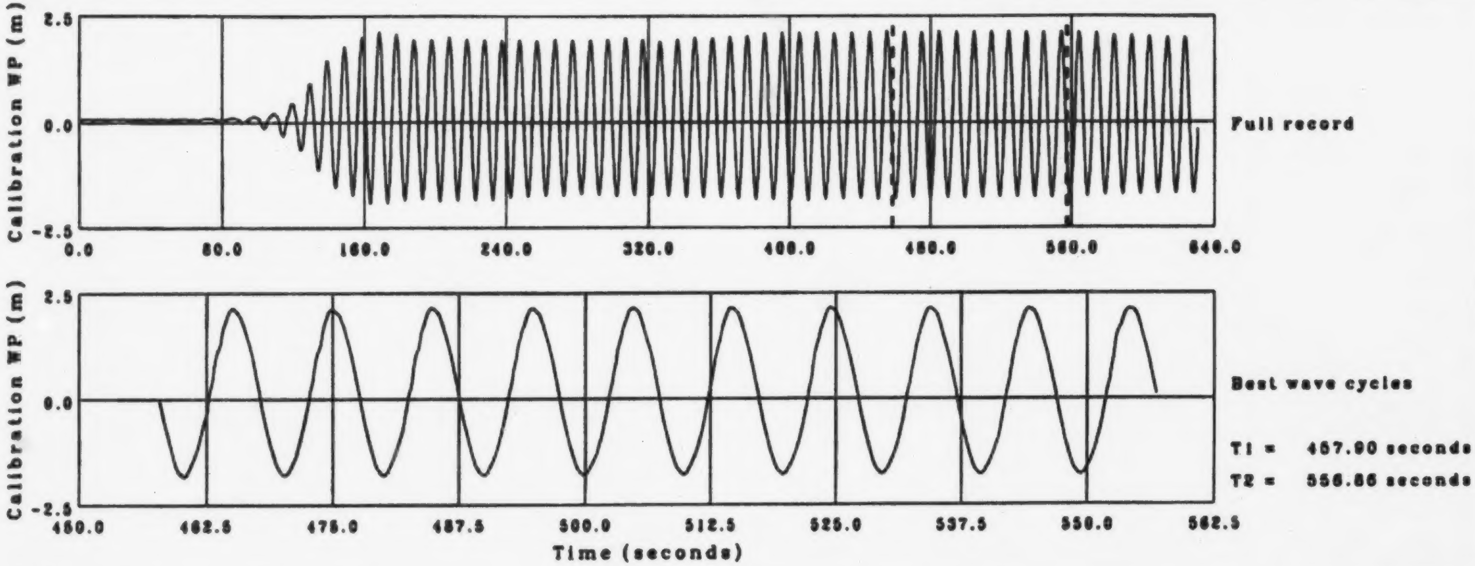
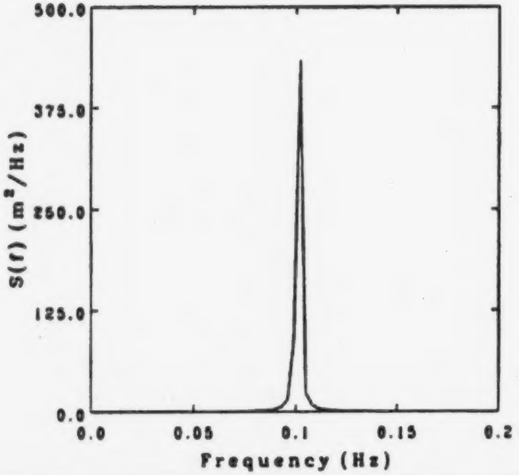
GENERATED BY:	CHECKED BY:	APPROVED BY:

Figure A2 REG_H2P10_T7P7_002

Offshore Evacuation Systems Performance
Regular Wave Calib
NRC-IMD
Analyzed: 06-FEB-2001 12:09:55
Acquired: 17-DEC-1999 09:57:24





		Target / (Tolerance):
Full record wave parameters:		
Average wave height	= 3.84 m	
Average wave period	= 9.90 seconds	
Best wave cycles parameters:		
Average wave height	= 3.92 m	3.96 m
Average wave period	= 9.90 seconds	9.90 seconds
Deviation from target height	= 0.89 %	(5.0 %)
Wave height stability	= 1.08 %	(5.0 %)
Wave crest stability	= 0.59 %	(2.5 %)

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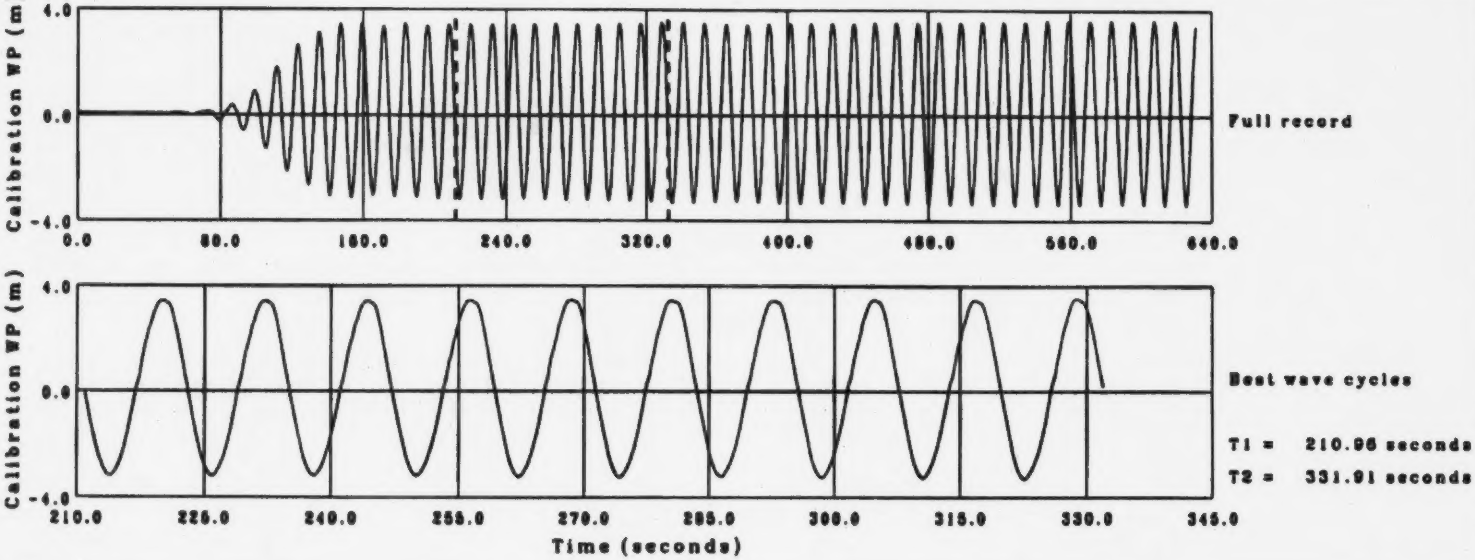
GENERATED BY:	CHECKED BY:	APPROVED BY:

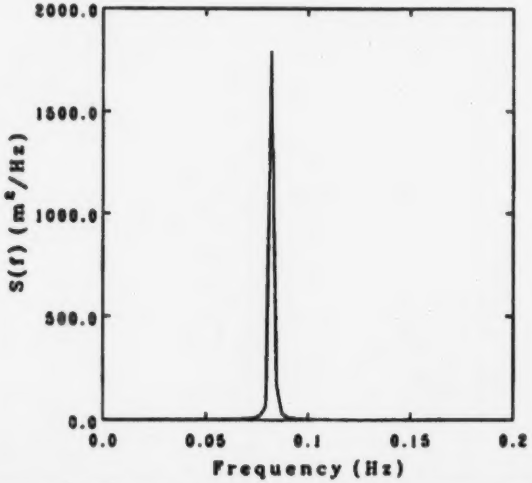
Figure A2 REG_H3P96_T9P9_002

Offshore Evacuation Systems Performance
Regular Wave Calib

NRC-IMD

Analyzed: 06-FEB-2001 12:11:36
Acquired: 17-DEC-1999 10:38:12





Full record wave parameters:		
Average wave height	= 6.80 m	
Average wave period	= 12.10 seconds	
Best wave cycles parameters:		**Target / (Tolerance):**
Average wave height	= 6.67 m	6.71 m
Average wave period	= 12.10 seconds	12.10 seconds
Deviation from target height	= 0.67 %	(5.0 %)
Wave height stability	= 1.78 %	(5.0 %)
Wave crest stability	= 0.81 %	(2.5 %)

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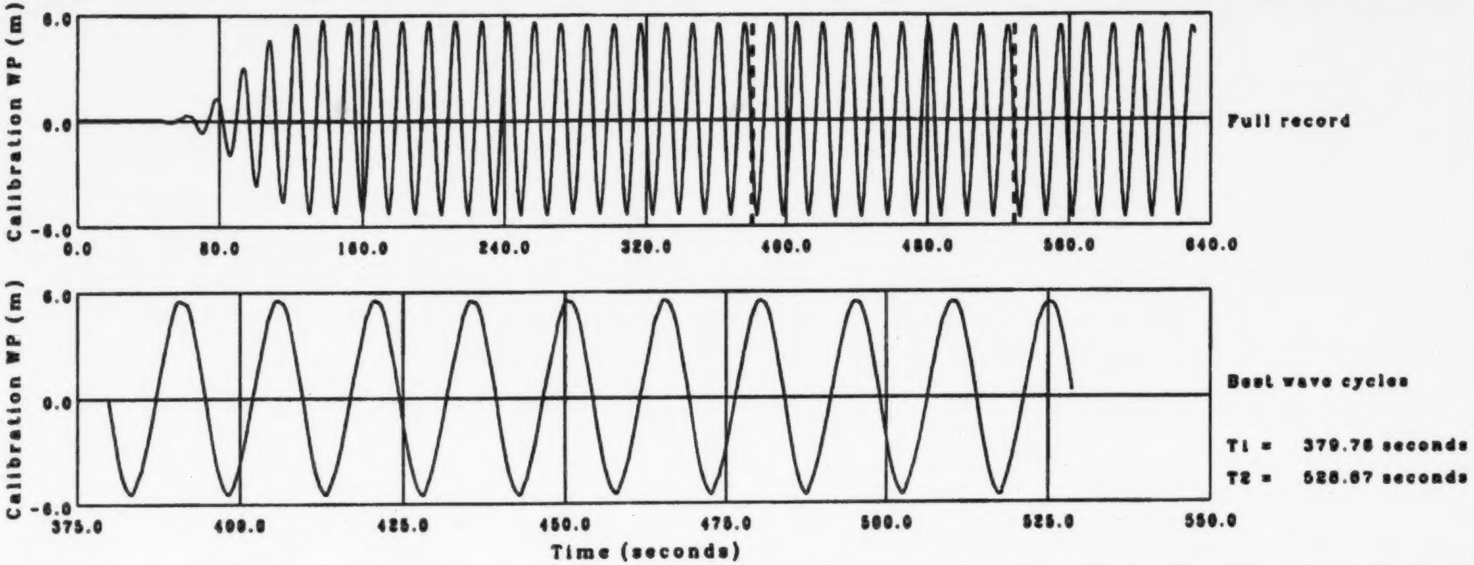
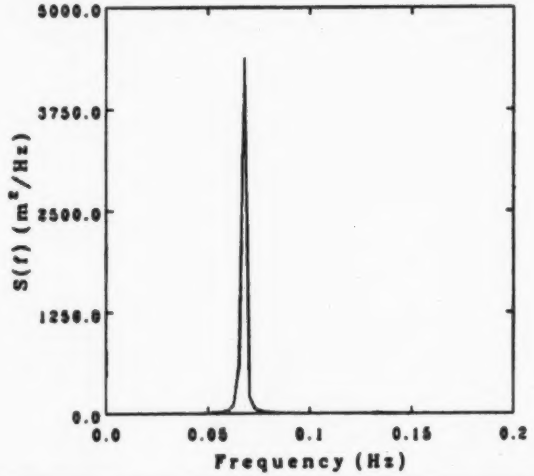
Figure A2 REG_H6P71_T12P 002

Offshore Evacuation Systems Performance
Regular Wave Calib

NRC-IMD

Analyzed: 06-FEB-2001 12:13:55
Acquired: 17-DEC-1999 12:26:06





Full record wave parameters:

Average wave height = 10.95 m
Average wave period = 14.90 seconds

Best wave cycles parameters:		**Target / (Tolerance):**
Average wave height	= 11.00 m	11.28 m
Average wave period	= 14.91 seconds	14.90 seconds
Deviation from target height	= 2.49 %	(5.0 %)
Wave height stability	= 1.09 %	(5.0 %)
Wave crest stability	= 1.09 %	(2.5 %)

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GENERATED BY:
CHECKED BY:
APPROVED BY:

Figure A2 REG_H11P28_T14P9_002

Appendix 7 Calibrated Sensors

Calibration of NEFF500 Channel 23 14:33 11 January 2000

Project: Evacuation Systems **Facility:** OEB

Sensor: FPSO-RMS **Model:** Qualisys **Serial Number:** #1

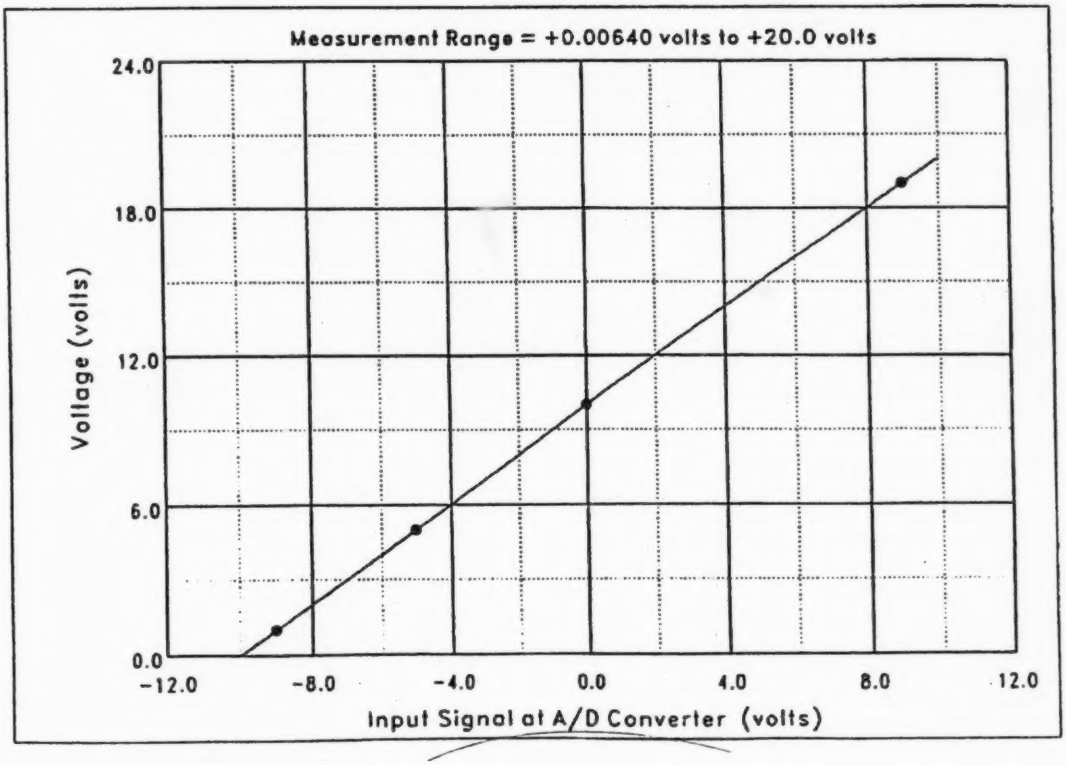
Programmable Gain: 1 **Plug-In Gain:** 1 **Filter Frequency:** 10.0 Hz

Data Point No.	Input Signal (volts)	Physical Value (volts)	Fitted Curve Value (volts)	Error (volts)	
1	−9.006	1.000	1.000	0.00022030	
2	−5.008	5.000	5.000	0.00001144	
3	−0.009	10.000	10.000	−0.00045967	⇐ Maximum Error
4	8.989	19.000	19.000	0.00022888	
Maximum Error = −0.00255 % of Calibration Range.					

Definition of Calibration Curve
Polynomial Degree = 1 (Linear Fit)

$$Y = C_0 + C_1 \cdot V$$

where $Y(t)$ = Voltage (volts),
$V(t)$ = input signal at A/D converter (volts),
C_0 = 10.0087 volts,
and C_1 = 1.00023 volts/volt.



Calibration of NEFF500 Channel 32 13:37 12 January 2000

Project: Evacuation Systems **Facility:** OEB

Sensor: Neff Sync. **Model:** N/A **Serial Number:** N/A

Programmable Gain: 1 **Plug-In Gain:** 1 **Filter Frequency:** 1.0 Hz

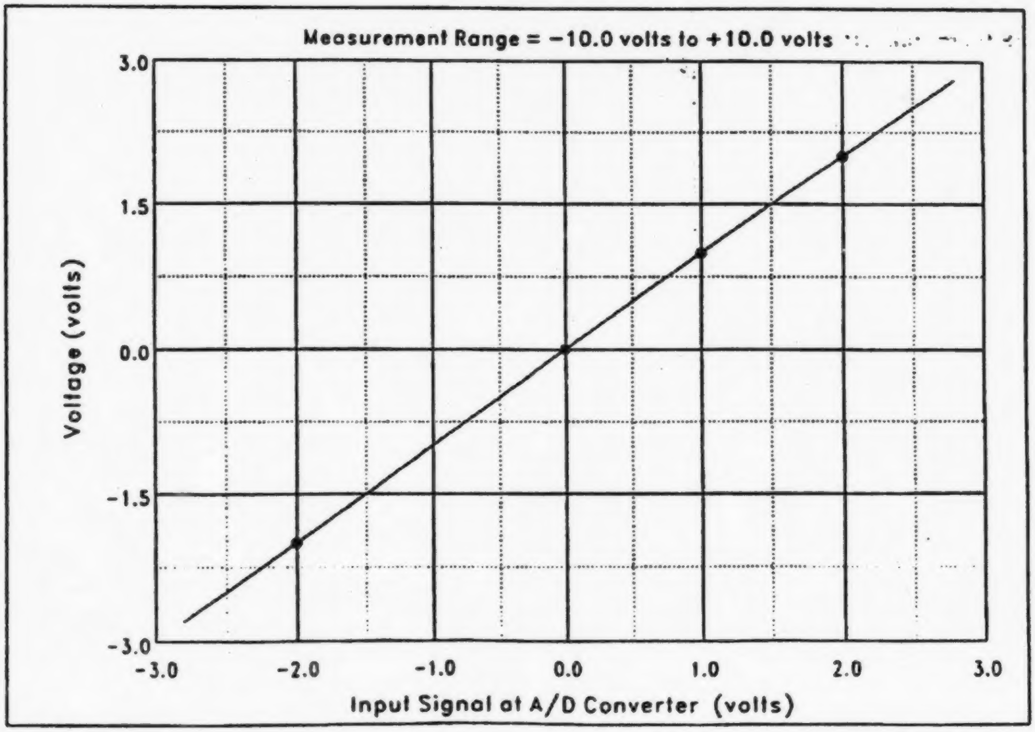
Data Point No.	Input Signal (volts)	Physical Value (volts)	Fitted Curve Value (volts)	Error (volts)	
1	−0.002	0.0000	0.0000	0.00000543	
2	0.997	1.0000	0.9998	−0.00019151	⇐ Maximum Error
3	1.997	2.0000	2.0001	0.00014091	
4	−2.002	−2.0000	−2.0000	0.00004530	

Maximum Error = −0.00479 % of Calibration Range.

Definition of Calibration Curve
Polynomial Degree = 1 (Linear Fit)

$$Y = C_0 + C_1 \cdot V$$

where $Y(t)$ = Voltage (volts),
$V(t)$ = input signal at A/D converter (volts),
C_0 = 0.00241471 volts,
and C_1 = 1.00031 volts/volt.



Calibration of NEFF500 Channel 22 14:25 11 January 2000

Project: Evacuation Systems **Facility:** OEB

Sensor: FPSO-Heading **Model:** Qualisys **Serial Number:** #1

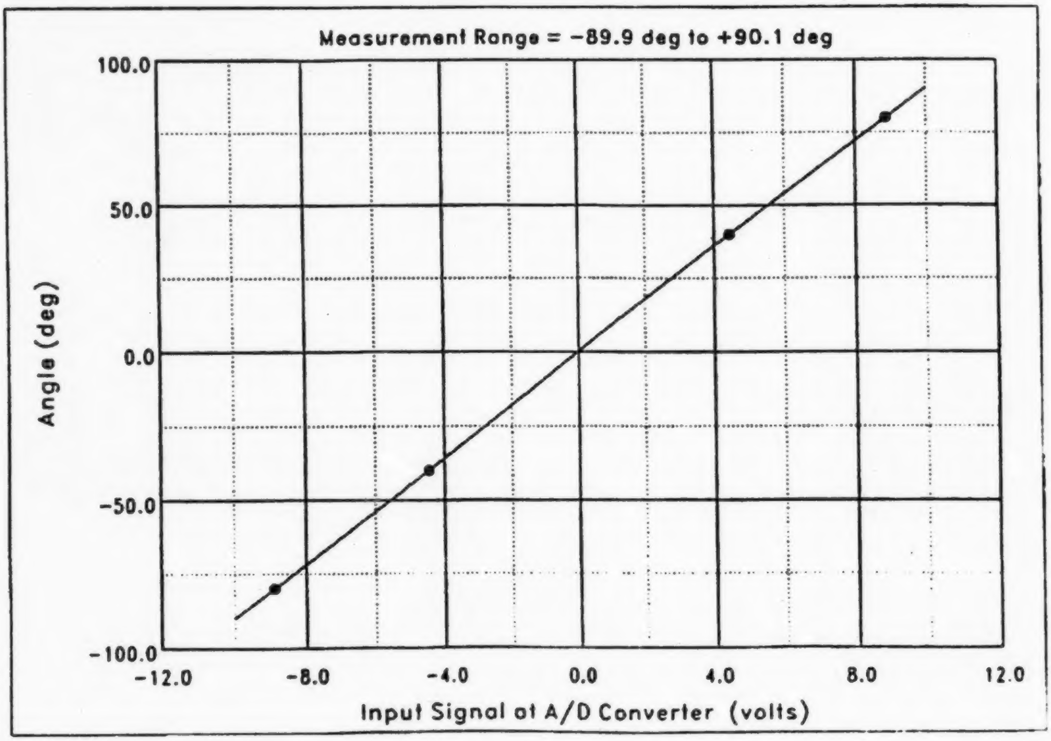
Programmable Gain: 1 **Plug-In Gain:** 1 **Filter Frequency:** 10.0 Hz

Data Point No.	Input Signal (volts)	Physical Value (deg)	Fitted Curve Value (deg)	Error (deg)	
1	8.879	80.000	80.003	0.0029984	
2	4.434	40.000	39.995	−0.0045280	⇐ Maximum Error
3	−4.453	−40.000	−39.998	0.0016060	
4	−8.898	−80.000	−80.000	−0.0000763	
Maximum Error = −0.00283 % of Calibration Range.					

Definition of Calibration Curve
Polynomial Degree = 1 (Linear Fit)

$$Y = C_0 + C_1 \cdot V$$

where $Y(t)$ = Angle (deg),
$V(t)$ = input signal at A/D converter (volts),
C_0 = 0.0827093 deg,
and C_1 = 9.00054 deg/volt.



Calibration of NEEF500 Channel 21 14:31 11 January 2000

Project: Evacuation Systems

Facility: OEB

Sensor: FPSO-Roll

Model: Qualisys

Serial Number: #1

Programmable Gain: 1

Plug-In Gain: 1

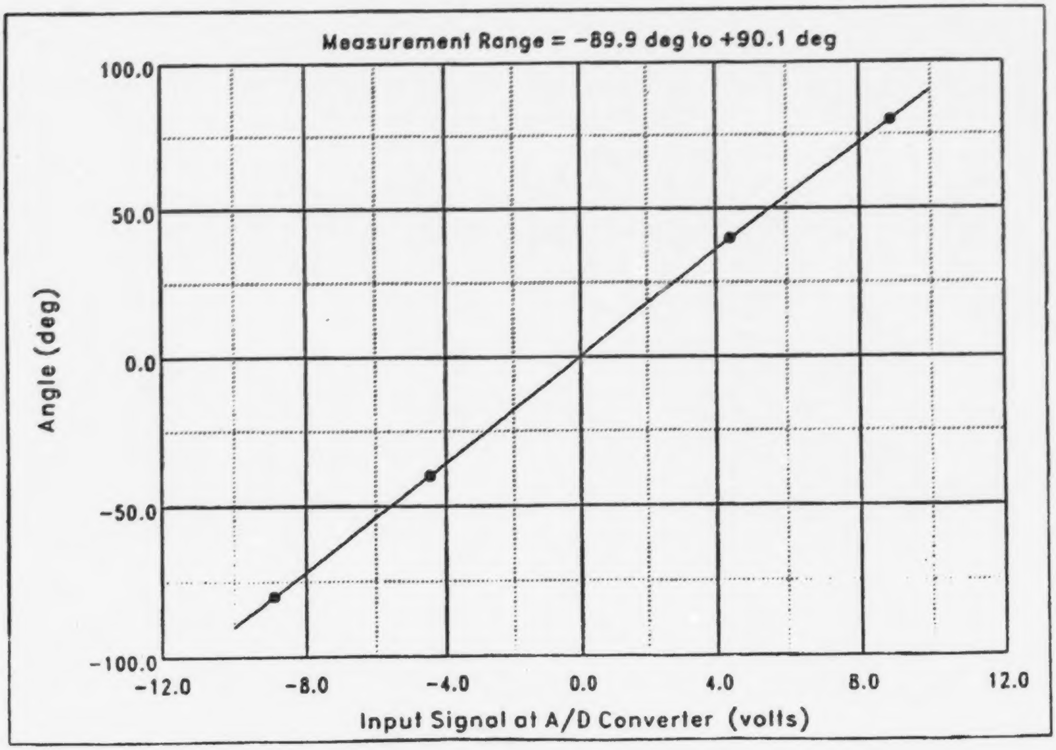
Filter Frequency: 10.0 Hz

Data Point No.	Input Signal (volts)	Physical Value (deg)	Fitted Curve Value (deg)	Error (deg)	
1	8.876	80.000	80.002	0.0021820	
2	4.432	40.000	39.996	−0.0037003	⇐ Maximum Error
3	−4.455	−40.000	−39.998	0.0023804	
4	−8.899	−80.000	−80.001	−0.0008545	
Maximum Error = −0.00231 % of Calibration Range.					

Definition of Calibration Curve
Polynomial Degree = 1 (Linear Fit)

$$Y = C_0 + C_1 \cdot V$$

where $Y(t)$ = Angle (deg),
$V(t)$ = input signal at A/D converter (volts),
C_0 = 0.100941 deg,
and C_1 = 9.00161 deg/volt.



Calibration of NEFF500 Channel 20 14:29 11 January 2000

Project: Evacuation Systems **Facility:** OEB

Sensor: FPSO-Pitch **Model:** Qualisys **Serial Number:** #1

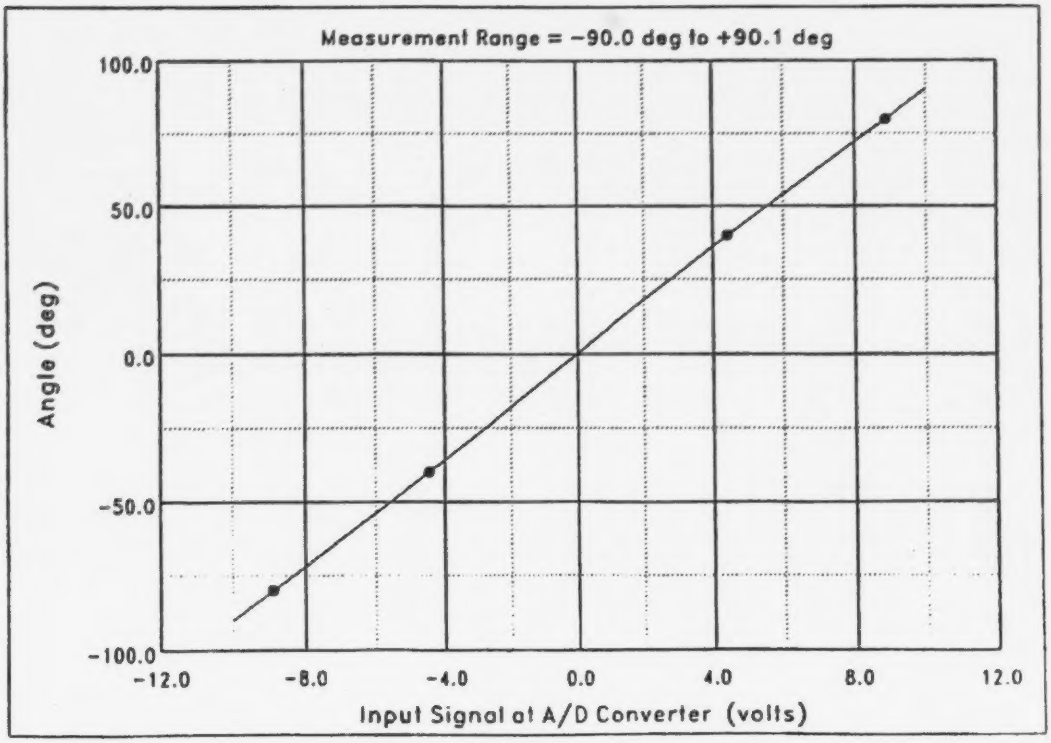
Programmable Gain: 1 **Plug-In Gain:** 1 **Filter Frequency:** 10.0 Hz

Data Point No.	Input Signal (volts)	Physical Value (deg)	Fitted Curve Value (deg)	Error (deg)	
1	4.433	40.000	39.995	−0.0045624	⇐ Maximum Error
2	8.876	80.000	80.003	0.0028763	
3	−4.451	−40.000	−39.998	0.0021896	
4	−8.894	−80.000	−80.001	−0.0005112	
Maximum Error = −0.00285 % of Calibration Range.					

Definition of Calibration Curve
Polynomial Degree = 1 (Linear Fit)

$$Y = C_0 + C_1 \cdot V$$

where $Y(t)$ = Angle (deg),
$V(t)$ = input signal at A/D converter (volts),
C_0 = 0.0821415 deg,
and C_1 = 9.00417 deg/volt.



Calibration of NEFF500 Channel 19 14:22 11 January 2000

Project: Evacuation Systems **Facility:** OEB

Sensor: FPSO-Z **Model:** Qualisys **Serial Number:** #2

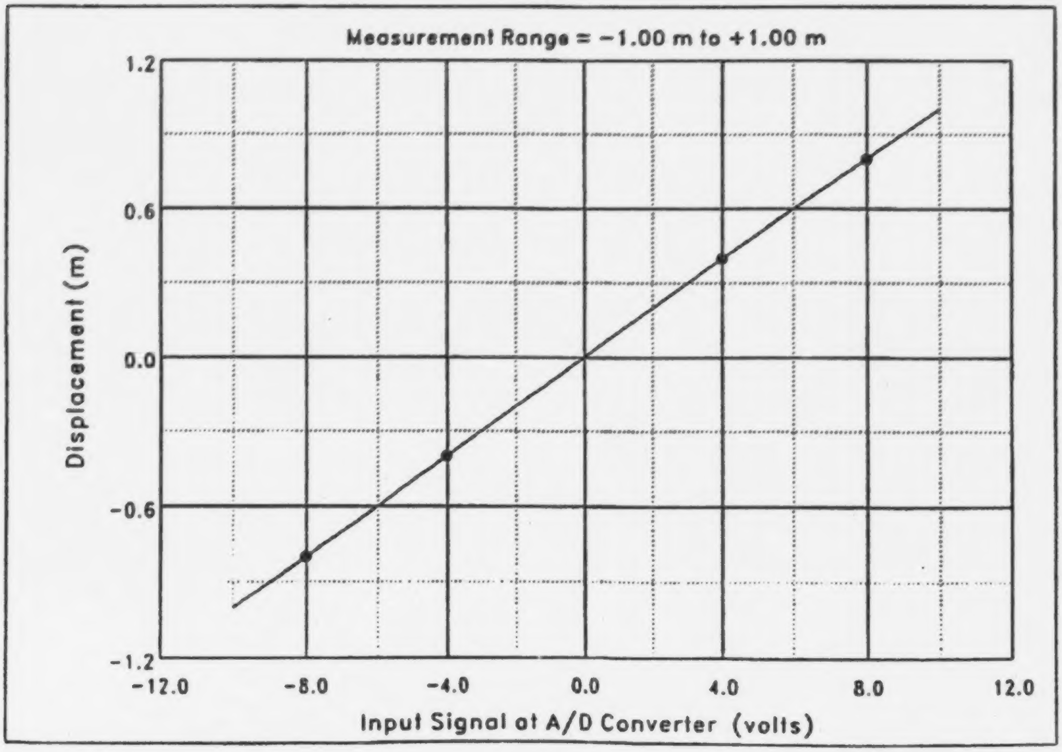
Programmable Gain: 1 **Plug-In Gain:** 1 **Filter Frequency:** 10.0 Hz

Data Point No.	Input Signal (volts)	Physical Value (m)	Fitted Curve Value (m)	Error (m)	
1	7.985	0.80000	0.80003	0.000025928	
2	3.987	0.40000	0.39995	−0.000050664	⇐ Maximum Error
3	−4.007	−0.40000	−0.39995	0.000048250	
4	−8.005	−0.80000	−0.80002	−0.000023484	
Maximum Error = −0.00317 % of Calibration Range.					

Definition of Calibration Curve
Polynomial Degree = 1 (Linear Fit)

$$Y = C_0 + C_1 \cdot V$$

where $Y(t)$ = Displacement (m),
$V(t)$ = input signal at A/D converter (volts),
C_0 = 0.00102649 m,
and C_1 = 0.100063 m/volt.



Calibration of NEFF500 Channel 18 14:20 11 January 2000

Project: Evacuation Systems **Facility:** OEB

Sensor: FPSO-Y **Model:** Qualisys **Serial Number:** #1

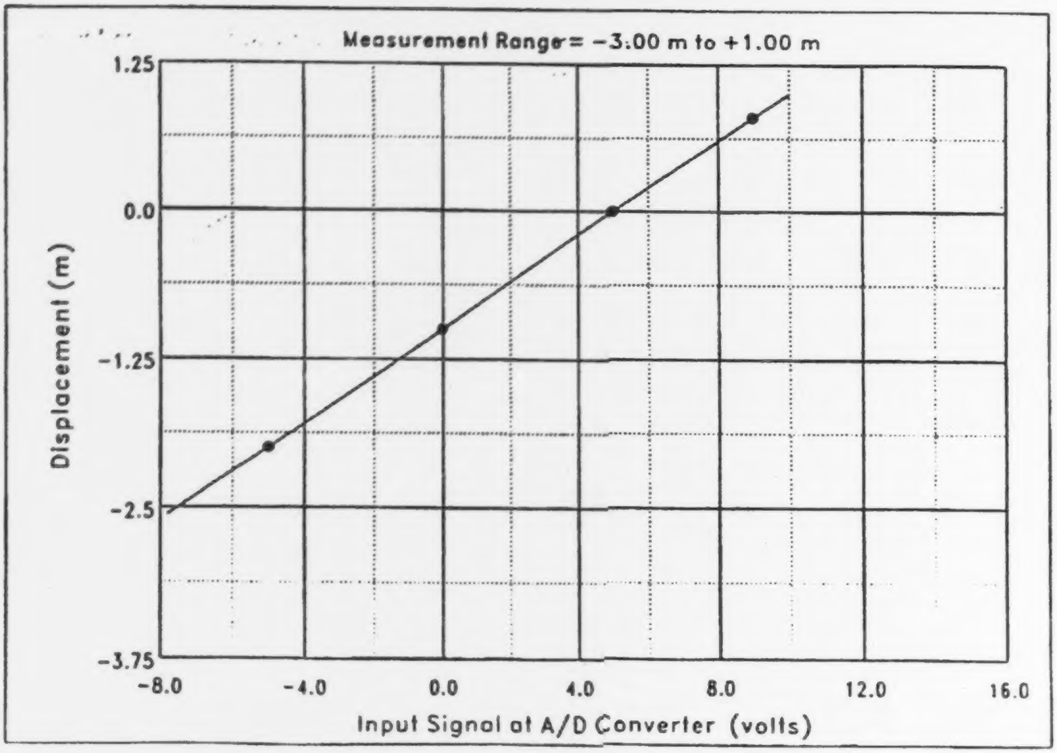
Programmable Gain: 1 **Plug-In Gain:** 1 **Filter Frequency:** 10.0 Hz

Data Point No.	Input Signal (volts)	Physical Value (m)	Fitted Curve Value (m)	Error (m)	
1	8.989	0.8000	0.8001	0.000073791	
2	4.990	0.0000	−0.0001	−0.000099540	⇐ Maximum Error
3	−0.008	−1.0000	−1.0000	−0.000007629	
4	−5.006	−2.0000	−2.0000	0.000033259	
Maximum Error = −0.00355 % of Calibration Range.					

Definition of Calibration Curve
Polynomial Degree = 1 (Linear Fit)

$$Y = C_0 + C_1 \cdot V$$

where $Y(t)$ = Displacement (m),
$V(t)$ = input signal at A/D converter (volts),
C_0 = −0.998451 m,
and C_1 = 0.200075 m/volt.



Calibration of NEFF500 Channel 17 14:18 11 January 2000

Project: Evacuation Systems **Facility:** OEB

Sensor: FPSO-X **Model:** Qualisys **Serial Number:** #1

Programmable Gain: 1 **Plug-In Gain:** 1 **Filter Frequency:** 10.0 Hz

Data Point No.	Input Signal (volts)	Physical Value (m)	Fitted Curve Value (m)	Error (m)	
1	8.681	0.8000	0.8000	0.000020027	
2	3.333	0.0000	−0.0001	−0.000056535	
3	−3.350	−1.0000	−0.9999	0.000077546	⇐ Maximum Error
4	−6.692	−1.5000	−1.5000	−0.000041008	
Maximum Error = 0.00337 % of Calibration Range.					

Definition of Calibration Curve

Polynomial Degree = 1 (Linear Fit)

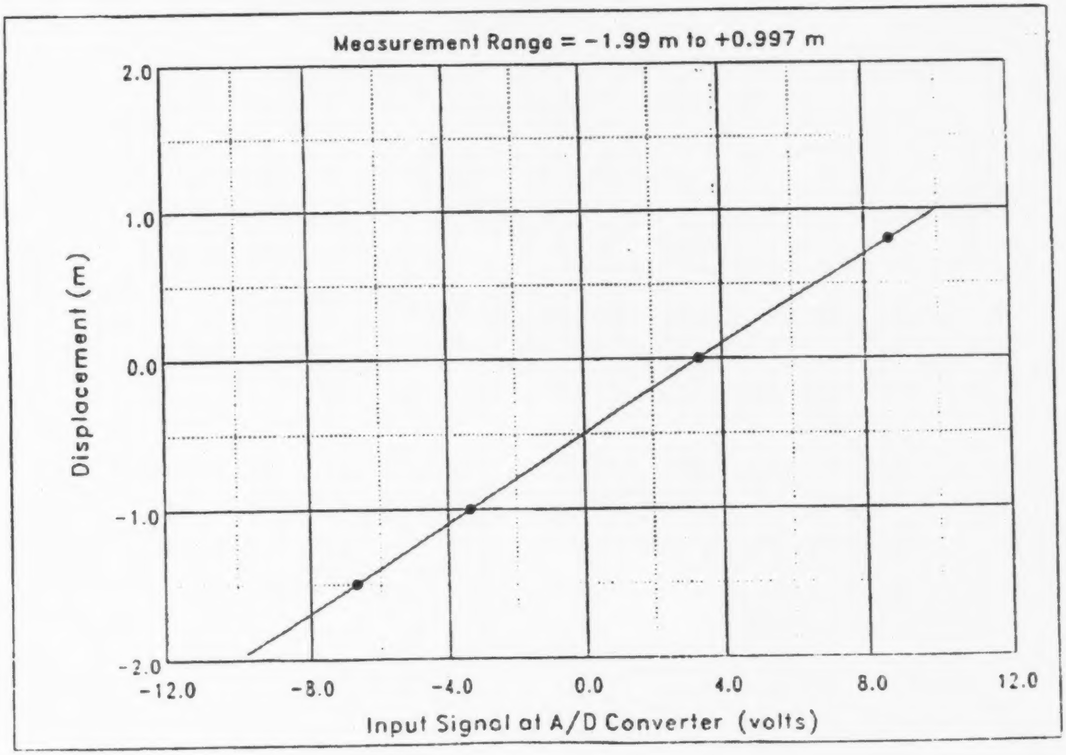
$$Y = C_0 + C_1 \cdot V$$

where $Y(t)$ = Displacement (m),

$V(t)$ = input signal at A/D converter (volts),

C_0 = −0.498775 m,

and C_1 = 0.149614 m/volt.



Calibration of NEFF500 Channel 16 20:58 11 January 2000

Project: Evacuation Systems **Facility:** OEB

Sensor: Inline Load **Model:** 60001-300 **Serial Number:** 00683214

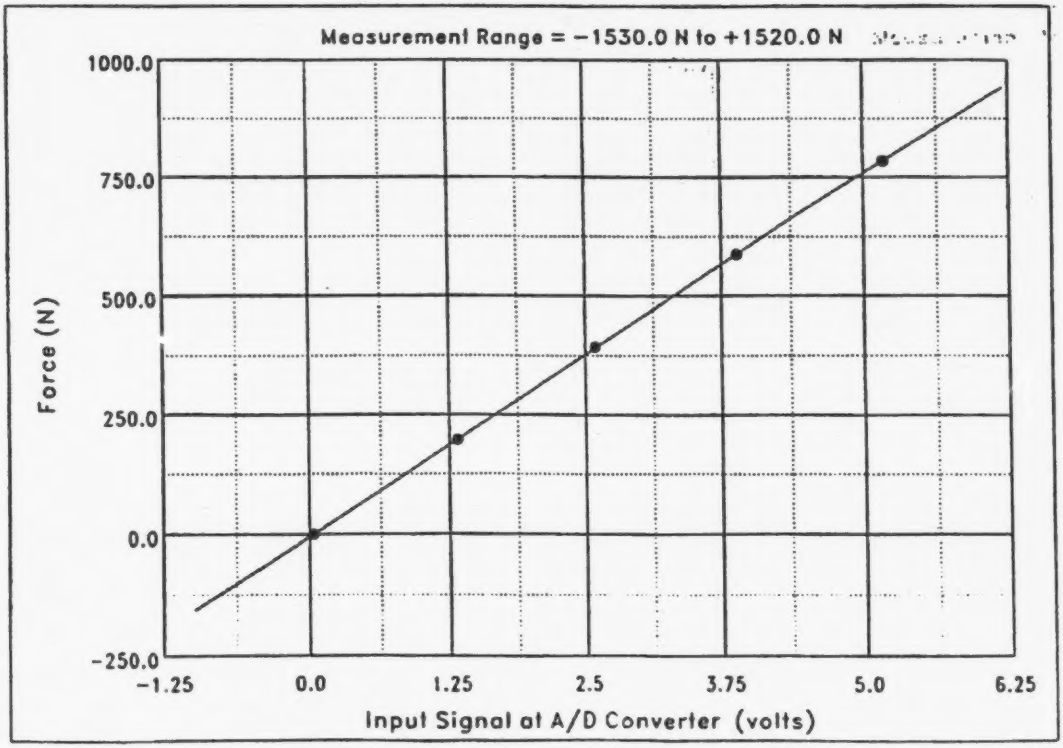
Programmable Gain: 1 **Plug-In Gain:** 200 **Filter Frequency:** 1.0 Hz

Data Point No.	Input Signal (volts)	Physical Value (N)	Fitted Curve Value (N)	Error (N)	
1	0.037	0.00	0.09	0.0882	
2	1.324	196.13	196.73	0.6003	
3	2.596	392.27	391.07	−1.2027	⇐ Maximum Error
4	3.890	588.40	588.66	0.2615	
5	5.174	784.54	784.79	0.2527	
Maximum Error = −0.153 % of Calibration Range.					

Definition of Calibration Curve
Polynomial Degree = 1 (Linear Fit)

$$Y = C_0 + C_1 \cdot V$$

where $Y(t)$ = Force (N),
$V(t)$ = input signal at A/D converter (volts),
C_0 = −5.53114 N,
and C_1 = 152.764 N/volt.



Calibration of DAQBOOK1 Channel 7 13:37 12 January 2000

Project: Evacuation Systems

Facility: OEB

Sensor: Daqbook Sync.

Model: N/A

Serial Number: N/A

Programmable Gain: 1

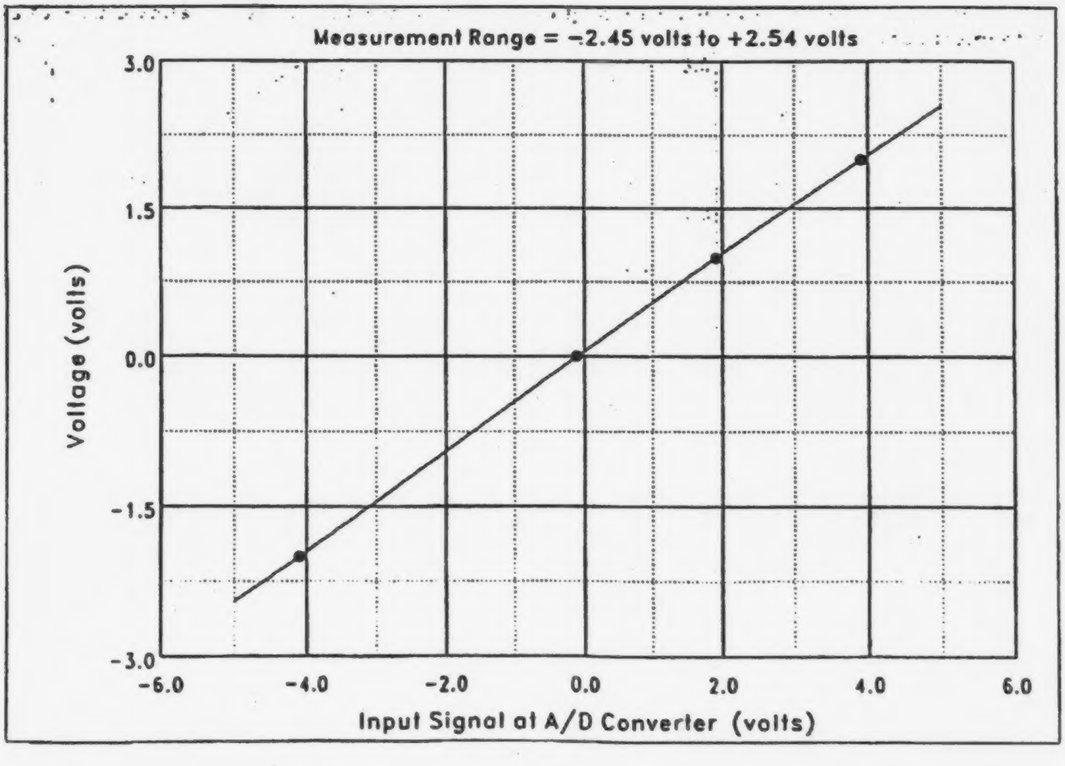
Plug-In Gain: 1

Data Point No.	Input Signal (volts)	Physical Value (volts)	Fitted Curve Value (volts)	Error (volts)	
1	−0.103	0.0000	−0.0050	−0.0050270	⇐ Maximum Error
2	1.919	1.0000	1.0038	0.0037715	
3	3.916	2.0000	1.9997	−0.0003257	
4	−4.099	−2.0000	−1.9984	0.0015812	
Maximum Error = −0.126 % of Calibration Range.					

Definition of Calibration Curve

Polynomial Degree = 1 (Linear Fit)

$$
\begin{aligned}
Y &= C_0 + C_1 \cdot V \\
\text{where } Y(t) &= \text{Voltage (volts)}, \\
V(t) &= \text{input signal at A/D converter (volts)}, \\
C_0 &= 0.0464106 \text{ volts}, \\
\text{and } C_1 &= 0.498827 \text{ volts/volt}.
\end{aligned}
$$



Measurement Range = −2.45 volts to +2.54 volts

Calibration of DAQBOOK1 Channel 6 16:11 12 January 2000

Project: Evacuation Systems **Facility:** OEB

Sensor: Wind Speed **Model:** N/A **Serial Number:** N/A

Programmable Gain: 1 **Plug-In Gain:** 1

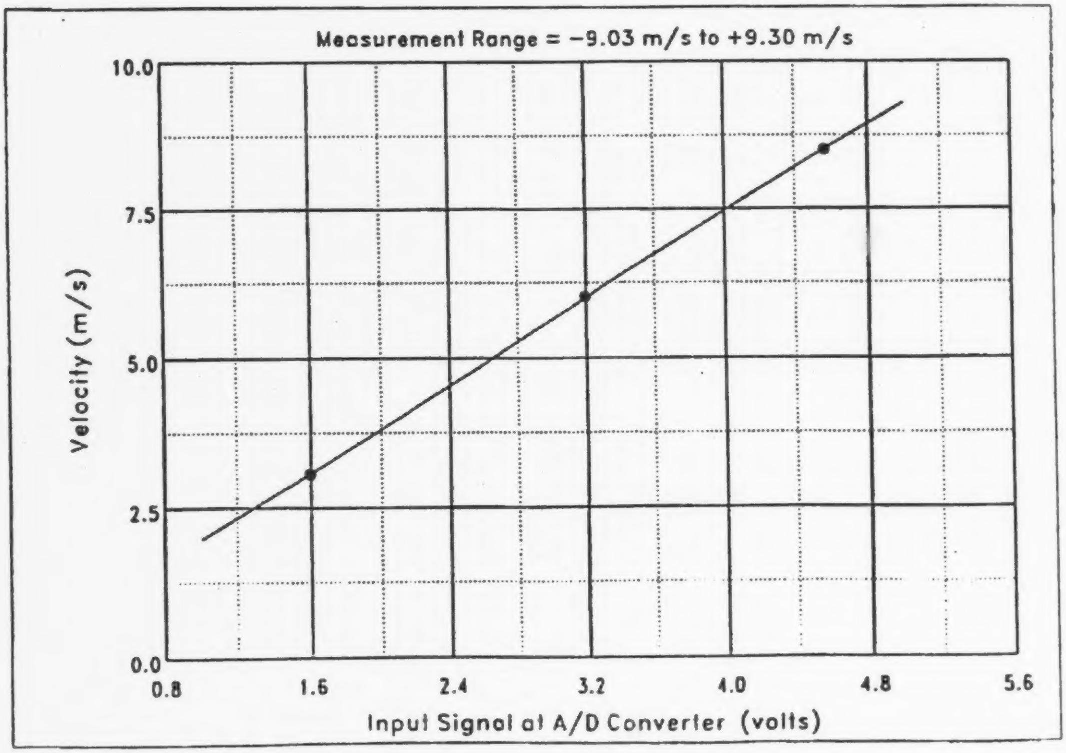
Data Point No.	Input Signal (volts)	Physical Value (m/s)	Fitted Curve Value (m/s)	Error (m/s)	
1	1.599	3.0550	3.0666	0.011558	
2	3.196	6.0200	5.9950	−0.024998	⇐ Maximum Error
3	4.570	8.5000	8.5134	0.013439	
Maximum Error = −0.459 % of Calibration Range.					

Definition of Calibration Curve

Polynomial Degree = 1 (Linear Fit)

$$Y = C_0 + C_1 \cdot V$$

where $Y(t)$ = Velocity (m/s),
$V(t)$ = input signal at A/D converter (volts),
C_0 = 0.136083 m/s,
and C_1 = 1.83323 (m/s)/volt.



Calibration of DAQBOOK1 Channel 8 14:15 12 January 2000

Project: Evacuation Systems

Facility: OEB

Sensor: Life Boat Release

Model: N/A

Serial Number: N/A

Programmable Gain: 1

Plug-In Gain: 1

Data Point No.	Input Signal (volts)	Physical Value (volts)	Fitted Curve Value (volts)	Error (volts)	
1	−0.038	0.0000	−0.0006	−0.0005882	
2	1.966	1.0000	1.0012	0.0011785	⇐ Maximum Error
3	3.964	2.0000	1.9994	−0.0005903	
Maximum Error = 0.0589 % of Calibration Range.					

Definition of Calibration Curve

Polynomial Degree = 1 (Linear Fit)

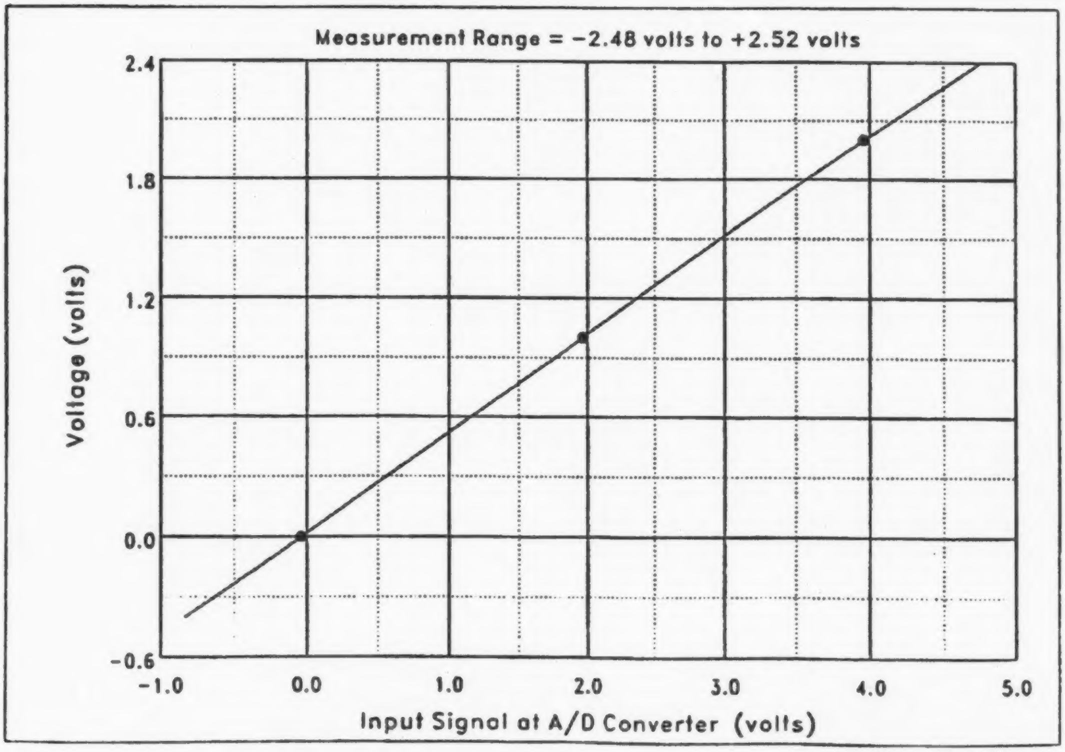
$$Y = C_0 + C_1 \cdot V$$

where $Y(t)$ = Voltage (volts),

$V(t)$ = input signal at A/D converter (volts),

C_0 = 0.0183557 volts,

and C_1 = 0.499813 volts/volt.



Calibration of DAQBOOK1 Channel 2 14:04 12 January 2000

Project: Evacuation Systems

Facility: OEB

Sensor: Life Boat Accel 1

Model: N/A

Serial Number: N/A

Programmable Gain: 1

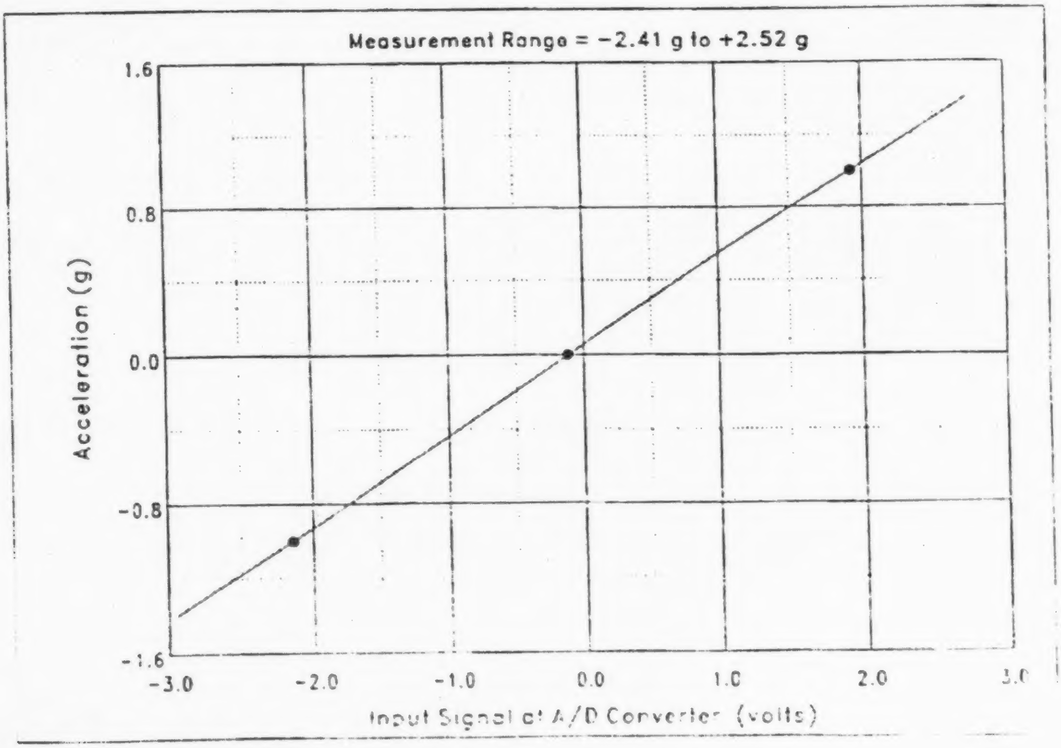
Plug-In Gain: 1

Data Point No.	Input Signal (volts)	Physical Value (g)	Fitted Curve Value (g)	Error (g)	
1	−0.115	0.0000	−0.0028	−0.0028351	⇐ Maximum Error
2	−2.137	−1.0000	−0.9986	0.0014235	
3	1.923	1.0000	1.0014	0.0014116	
Maximum Error = −0.142 % of Calibration Range.					

Definition of Calibration Curve
Polynomial Degree = 1 (Linear Fit)

$$Y = C_0 + C_1 \cdot V$$

where $Y(t)$ = Acceleration (g),
$V(t)$ = input signal at A/D converter (volts),
C_0 = 0.0540222 g,
and C_1 = 0.492584 g/volt.



Calibration of DAQBOOK1 Channel 4 13:51 12 January 2000

Project: Evacuation Systems **Facility:** OEB

Sensor: DAvit Payout **Model:** N/A **Serial Number:** N/A

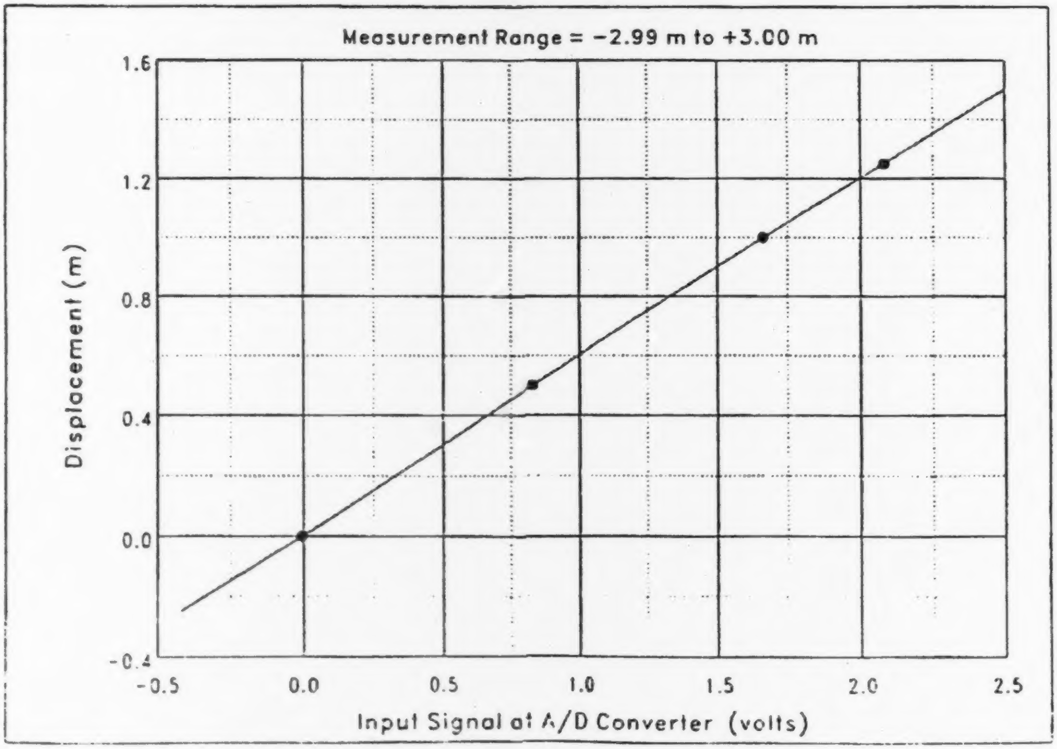
Programmable Gain: 1 **Plug-In Gain:** 1

Data Point No.	Input Signal (volts)	Physical Value (m)	Fitted Curve Value (m)	Error (m)	
1	−0.004	0.0000	0.0002	0.00022804	
2	0.829	0.5000	0.4998	−0.00020349	
3	1.663	1.0000	0.9995	−0.00052720	⇐ Maximum Error
4	2.081	1.2500	1.2505	0.00050271	
Maximum Error = −0.0422 % of Calibration Range.					

Definition of Calibration Curve
Polynomial Degree = 1 (Linear Fit)

$$Y = C_0 + C_1 \cdot V$$

where $Y(t)$ = Displacement (m),
$V(t)$ = input signal at A/D converter (volts),
C_0 = 0.00265644 m,
and C_1 = 0.599531 m/volt.



Calibration of DAQBOOK1 Channel 5 13:55 12 January 2000

Project: Evacuation Systems

Facility: OEB

Sensor: Flexible Boom Position

Model: N/A

Serial Number: N/A

Programmable Gain: 1

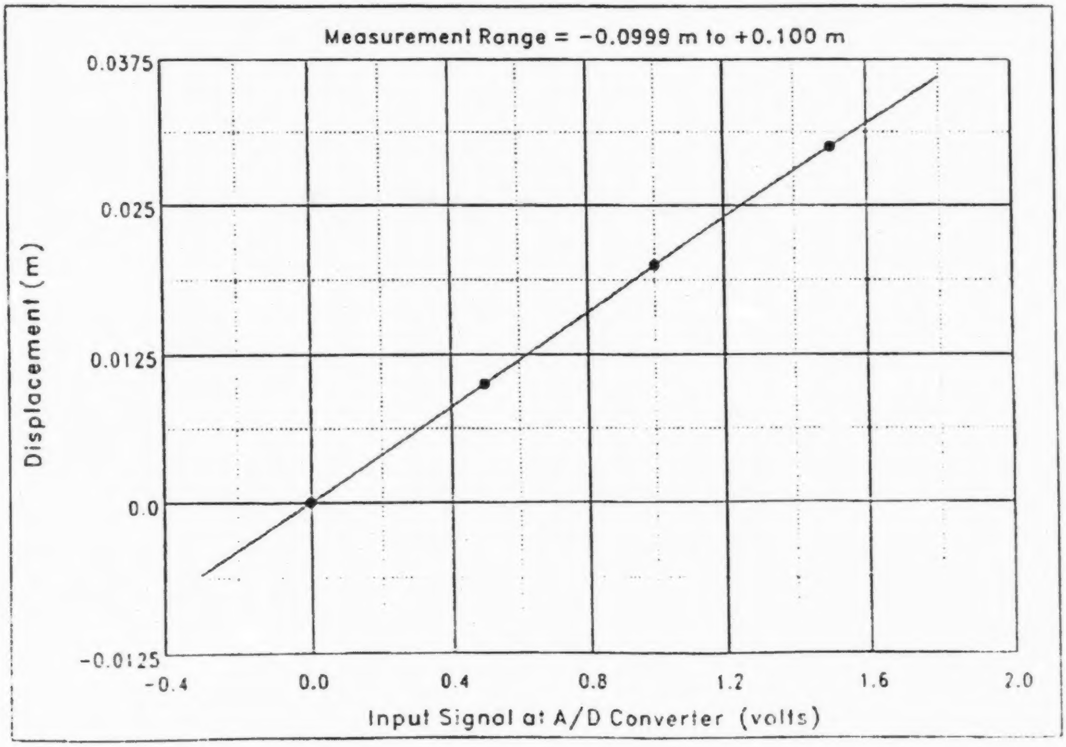
Plug-In Gain: 1

Data Point No.	Input Signal (volts)	Physical Value (m)	Fitted Curve Value (m)	Error (m)	
1	−0.001	0.000000	−0.000004	$-0.43397E-05$	
2	0.500	0.010000	0.010004	$0.44713E-05$	⇐ Maximum Error
3	1.000	0.020000	0.020004	$0.40848E-05$	
4	1.500	0.030000	0.029996	$-0.42152E-05$	
Maximum Error = 0.0149 % of Calibration Range.					

Definition of Calibration Curve
Polynomial Degree = 1 (Linear Fit)

$$Y = C_0 + C_1 \cdot V$$

where $Y(t)$ = Displacement (m),
$V(t)$ = input signal at A/D converter (volts),
C_0 = 0.0000191589 m,
and C_1 = 0.0199868 m/volt.



Calibration of DAQBOOK1 Channel 1 13:45 12 January 2000

Project: Evacuation Systems

Facility: OEB

Sensor: Flexible Boom Load

Model: Mini Cell

Serial Number: N/A

Programmable Gain: 1

Plug-In Gain: 1

Data Point No.	Input Signal (volts)	Physical Value (N)	Fitted Curve Value (N)	Error (N)	
1	0.013	0.000	−0.016	−0.015811	
2	0.537	5.000	4.997	−0.002934	
3	1.067	10.010	10.064	0.054154	⇐ Maximum Error
4	1.582	15.020	14.985	−0.035411	
Maximum Error = 0.361 % of Calibration Range.					

Definition of Calibration Curve

Polynomial Degree = 1 (Linear Fit)

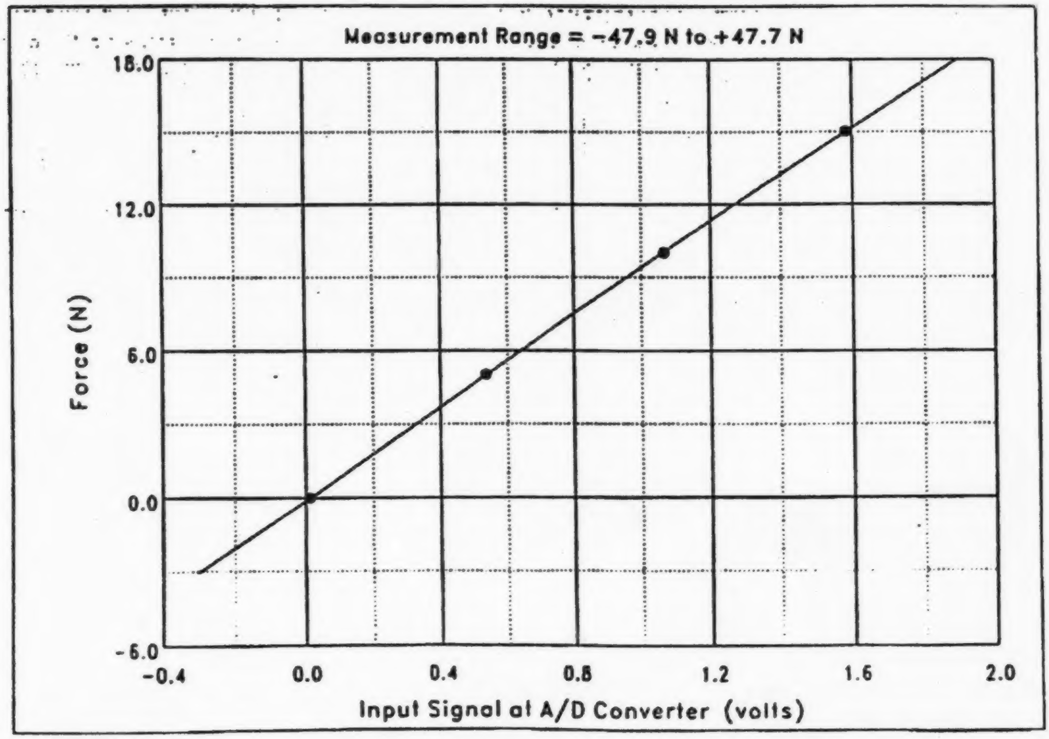
$$Y = C_0 + C_1 \cdot V$$

where $Y(t)$ = Force (N),

$V(t)$ = input signal at A/D converter (volts),

C_0 = −0.140305 N,

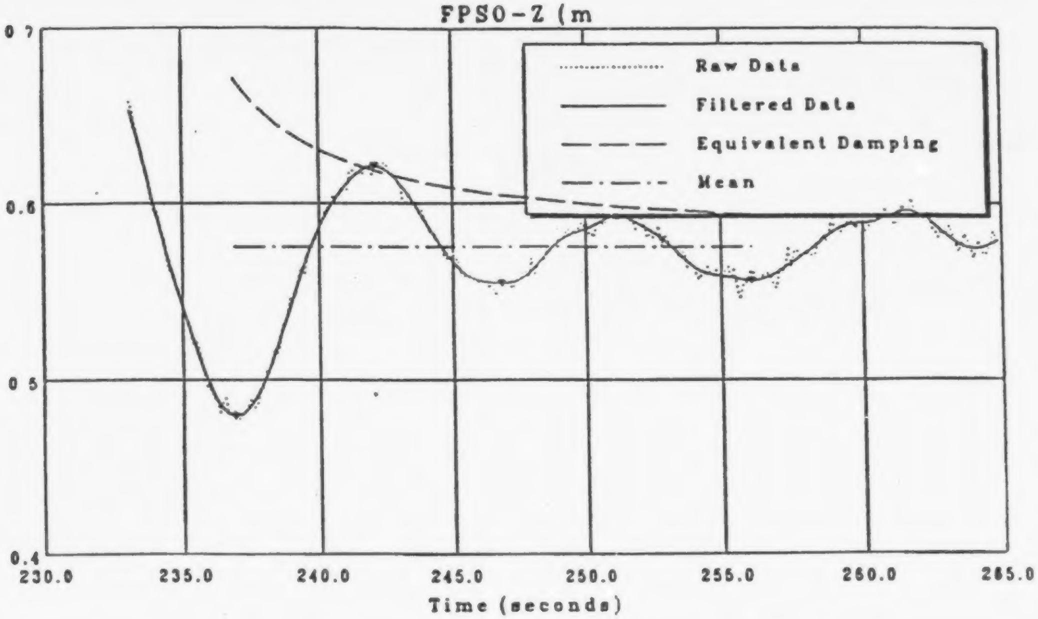
and C_1 = 9.55940 N/volt.

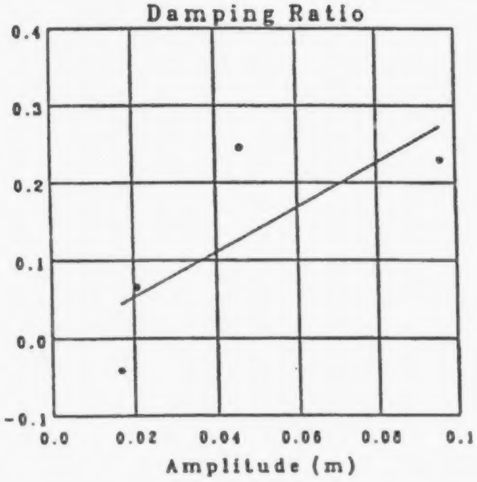


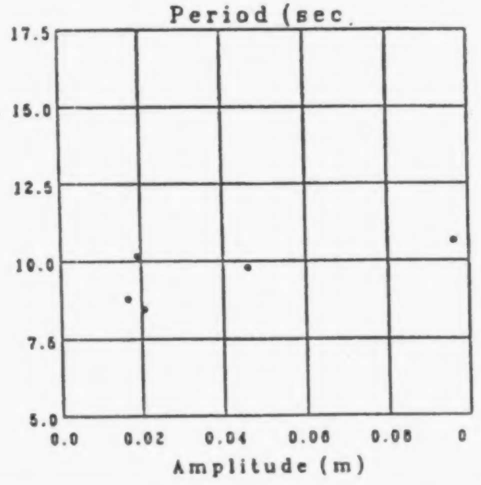
Appendix 8 Qualification, Decay and Verification Tests

Evacuation Systems – **IMD**

Analyzed: 29-FEB-2000 16:26:54
Acquired: 11-JAN-2000 16:22:00


FPSO-Z (m


Damping Ratio


Period (sec

MEAN

Offset = 0.5755 m
Period = 9.560 sec

DAMPING

Linear = 0.1245
Equivalent B1 = -0.005606
Equivalent B2 = 2.892

National Research Council Canada
Institute for Marine Dynamics

FPSO-Z
Test913_213_003

No Mooring

FPSO-Z (m)

Offset	Average Period	Linear Damping Coefficient	Equivalent Damping Slope	Equivalent Damping Offset
0.5755	9.5598	0.12447	2.89153	-0.00561

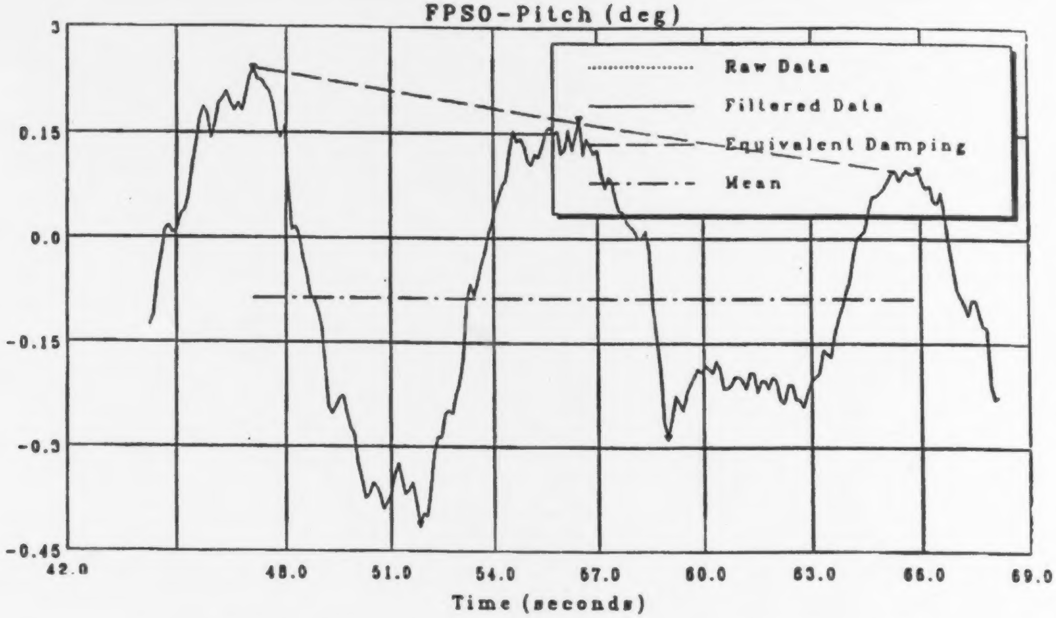
FPSO-Z (m)

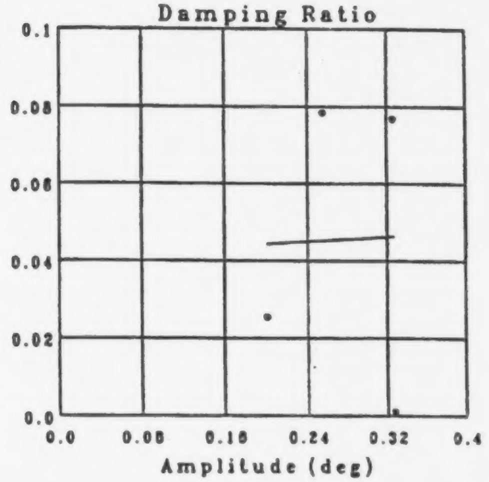
Amplitude	ABS(Amplitude-Offset)	Damping Ratio	Period
0.4791	0.0964	0.22903	10.6444
0.6215	0.0460	0.24604	9.7822
0.5548	0.0207	0.06477	8.4335
0.5924	0.0169	-0.04195	8.7761
0.5563	0.0193		10.1625

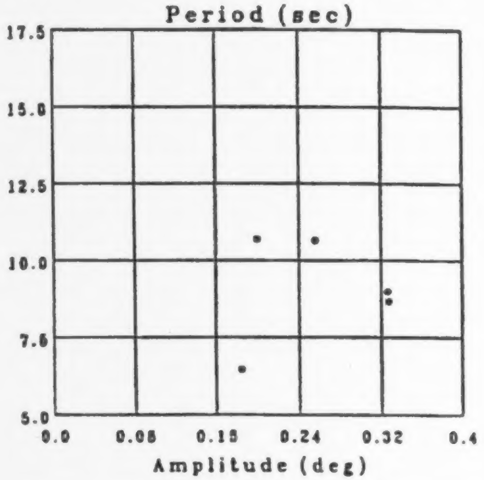
Evacuation Systems

IMD

Analyzed: 29-FEB-2000 11:45:37
Acquired: 11-JAN-2000 15:09:23







MEAN	DAMPING
Offset = -0.08606 deg	Linear = 0.04547
Period = 9.081 sec	Equivalent B1 = 0.04127
	Equivalent B2 = 0.01513

National Research Council Canada
Institute for Marine Dynamics

FPSO-Pitch
test913_212_001

No Mooring

FPSO-Pitch (deg)

Offset	Average Period	Linear Damping Coefficient	Equivalent Damping Slope	Equivalent Damping Offset
-0.0861	9.0806	0.04547	0.01513	0.04127

FPSO-Pitch (deg)

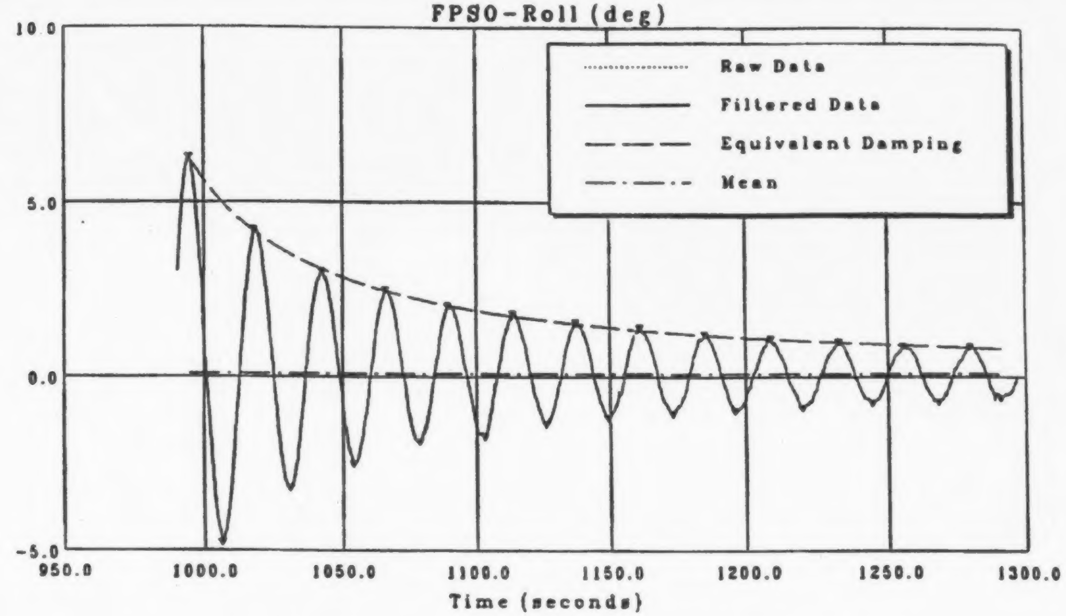
Amplitude	ABS(Amplitude-Offset)	Damping Ratio	Period
0.2415	0.3276	0.00111	8.6584
-0.4125	0.3264	0.07695	8.9758
0.1701	0.2561	0.07845	10.6347
-0.2861	0.2000	0.02536	10.6762
0.0986	0.1847		6.4580

Evacuation Systems

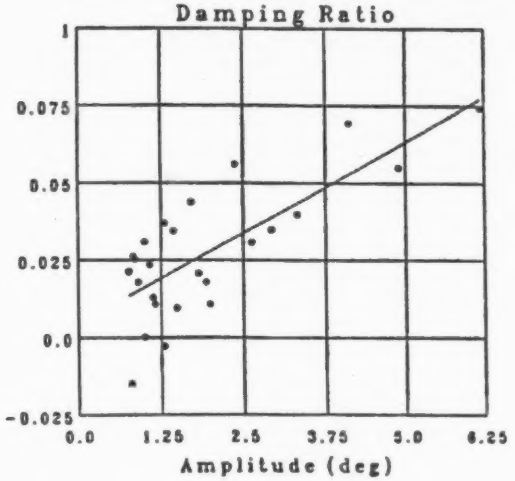
IMD

Analyzed: 29-FEB-2000 11:35:48
Acquired: 11-JAN-2000 15:02:42

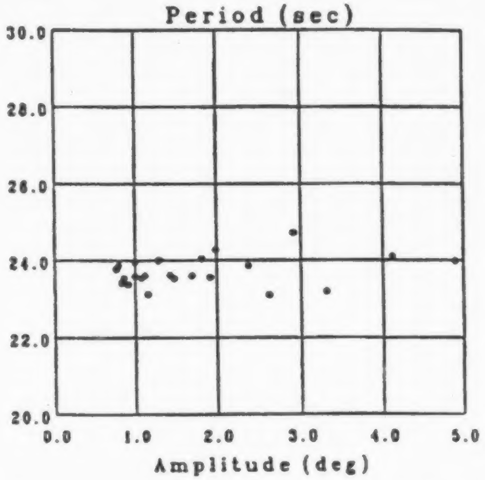
FPSO-Roll (deg)



Damping Ratio



Period (sec)



MEAN

Offset = 0.09532 deg
Period = 23.72 sec

DAMPING

Linear = 0.02737
Equivalent B1 = 0.004265
Equivalent B2 = 0.01179

National Research Council Canada
Institute for Marine Dynamics

FPSO-Roll
test913_211_001

No Mooring

FPSO-Roll (deg)

Offset	Average Period	Linear Damping Coefficient	Equivalent Damping Slope	Equivalent Damping Offset
0.0953	23.7192	0.02737	0.01179	0.00426

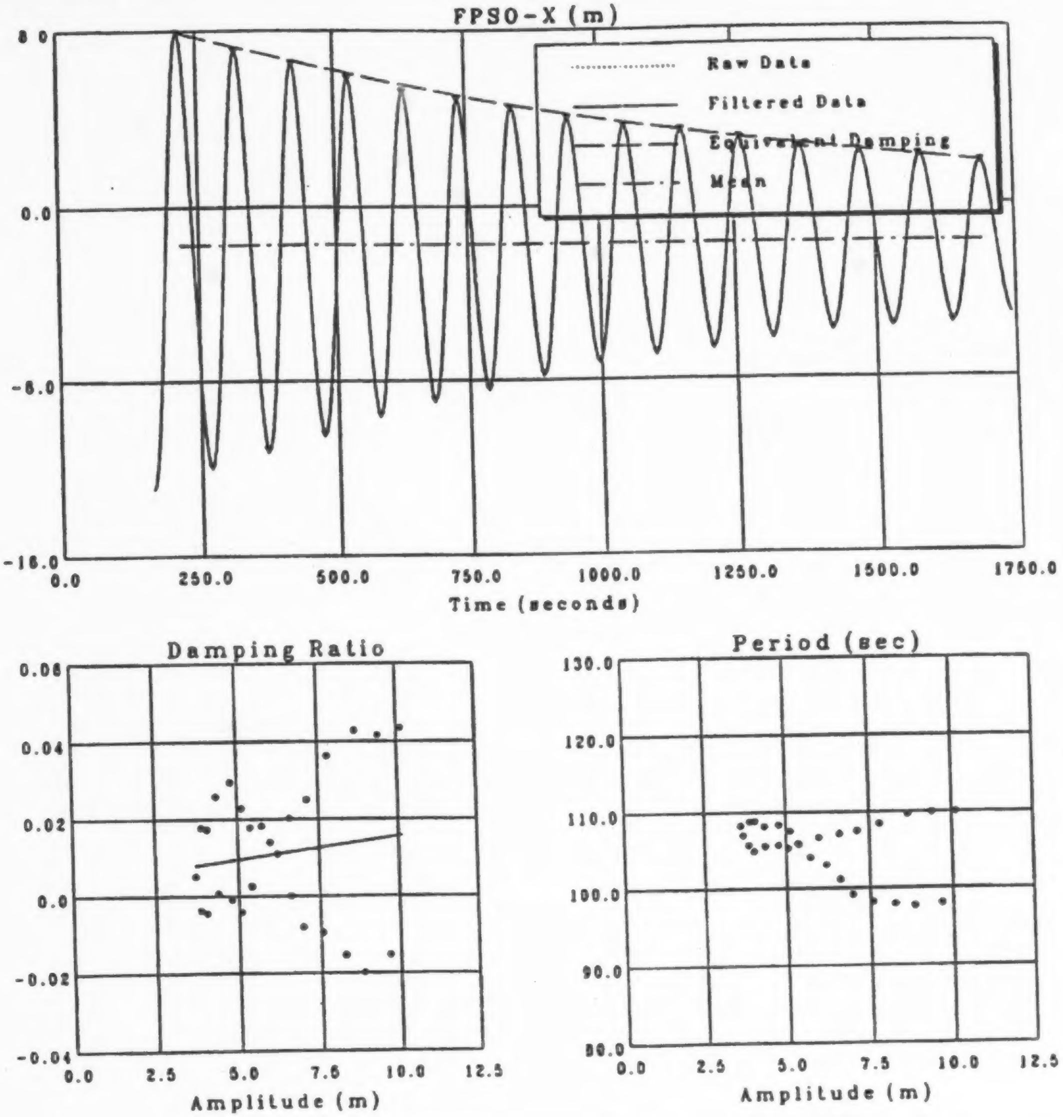
FPSO-Roll (deg)

Amplitude	ABS(Amplitude-Offset)	Damping Ratio	Period
6.2875	6.1922	0.07425	
-4.8055	4.9008	0.05509	23.9863
4.2162	4.1209	0.06930	24.0912
-3.2176	3.3129	0.03982	23.1870
3.0184	2.9231	0.03474	24.7075
-2.5253	2.6207	0.03076	23.0957
2.4745	2.3792	0.05608	23.8474
-1.8990	1.9943	0.01066	24.2627
2.0240	1.9286	0.01775	23.5601
-1.7287	1.8240	0.02075	24.0449
1.8042	1.7089	0.04383	23.6028
-1.3935	1.4888	0.00948	23.5295
1.5405	1.4451	0.03452	23.6157
-1.2012	1.2965	-0.00275	23.9822
1.4031	1.3078	0.03686	24.0171
-1.0693	1.1647	0.01061	23.1089
1.2218	1.1265	0.01274	23.6025
-0.9869	1.0822	0.02338	23.5378
1.1009	1.0056	0.00008	23.5769
-0.9100	1.0053	0.03093	23.9583
1.0075	0.9122	0.01783	23.3691
-0.7672	0.8625	0.02520	23.5176
0.8921	0.7968	-0.01491	23.8750
-0.7397	0.8350	0.02606	23.4160
0.8647	0.7693	0.02125	23.7693
-0.6243	0.7196		

Evacuation Systems

IMD

Analyzed: 29-FEB-2000 14:42:38
Acquired: 11-JAN-2000 21:44:35



MEAN

Offset = -1.733 m
Period = 105.3 sec

DAMPING

Linear = 0.01108
Equivalent B1 = 0.003441
Equivalent B2 = 0.001225

National Research Council Canada
Institute for Marine Dynamics

FPSO-X
Test913_217_001

Mooring

FPSO-X (m,

Offset	Average Period	Linear Damping Coefficient	Equivalent Damping Slope	Equivalent Damping Offset
-1.7334	105.3106	0.01108	0.00122	0.00344

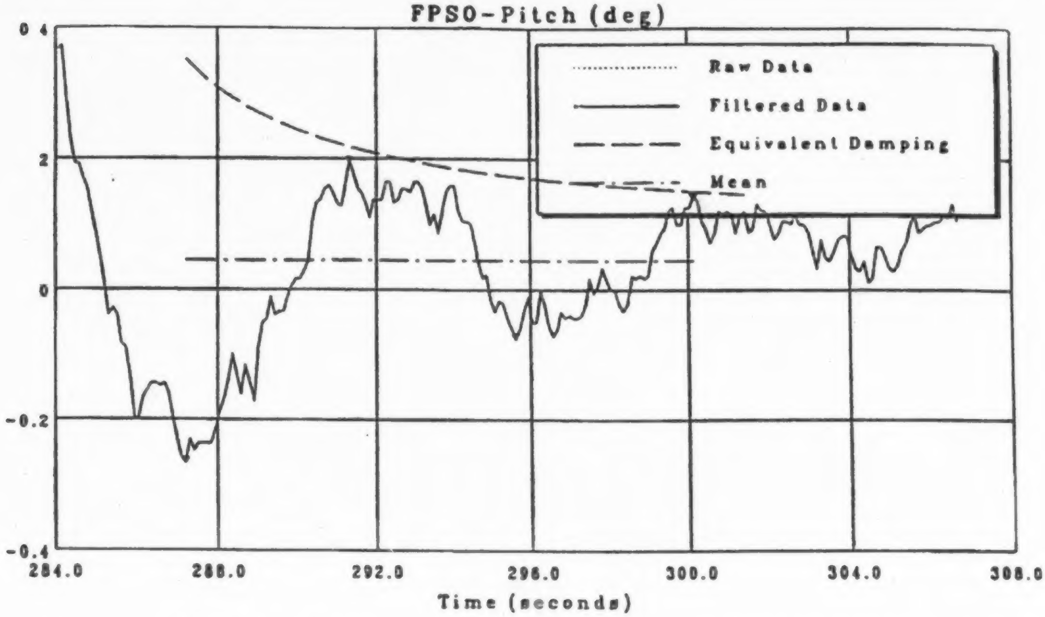
FPSO-X (m)

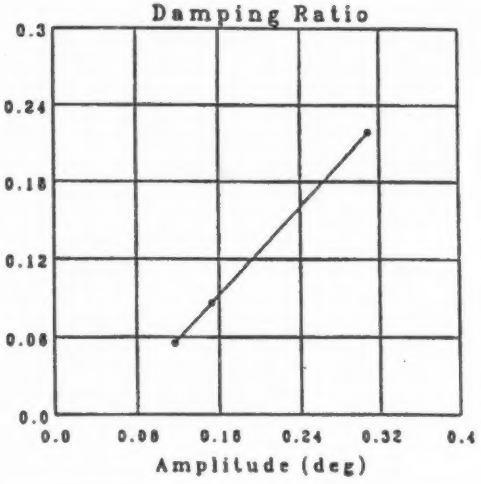
Amplitude	ABS(Amplitude-Offset)	Damping Ratio	Period
7.9289	9.6623	-0.01548	97.9522
-11.8772	10.1438	0.04351	110.0223
7.1133	8.8467	-0.01987	97.6175
-11.1500	9.4166	0.04154	109.9539
6.5300	8.2635	-0.01553	97.9217
-10.4102	8.6767	0.04290	109.6181
5.8483	7.5817	-0.00968	98.1926
-9.5491	7.8157	0.03628	108.4526
5.2398	6.9732	-0.00816	99.1146
-8.8876	7.1542	0.02507	107.5206
4.8787	6.6121	-0.00008	101.1089
-8.3472	6.6138	0.02028	107.1086
4.4722	6.2056	0.01098	103.0286
-7.7286	5.9952	0.01393	106.6392
4.0050	5.7385	0.01835	104.0740
-7.1504	5.4170	0.00248	105.7584
3.6414	5.3749	0.01788	105.8605
-6.8146	5.0811	-0.00414	105.2764
3.4142	5.1476	0.02286	107.5229
-6.5242	4.7908	-0.00106	105.6934
3.0733	4.8067	0.02964	108.3318
-6.1126	4.3792	0.00067	105.5479
2.6365	4.3699	0.02591	108.1553
-5.7616	4.0282	-0.00442	104.9106
2.3512	4.0846	0.01724	108.8401
-5.6026	3.8692	-0.00378	105.7434
2.1820	3.9154	0.01779	108.7629
-5.4359	3.7025	0.00518	106.9910
1.9093	3.6427		108.2874

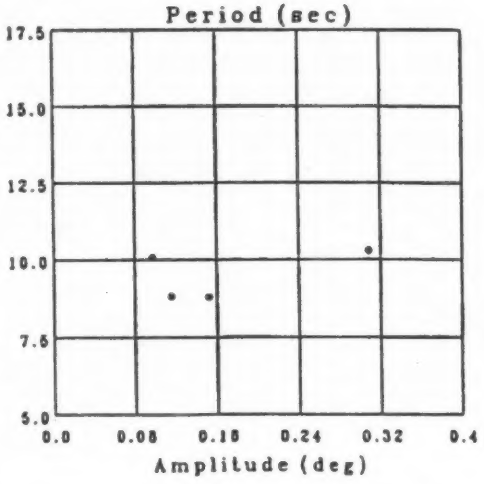
Evacuation Systems

IMD

Analyzed: 29-FEB-2000 12:14:04
Acquired: 11-JAN-2000 21:26:25







MEAN	DAMPING
Offset = 0.04473 deg	Linear = 0.1200
Period = 9.483 sec	Equivalent B1 = -0.04355
	Equivalent B2 = 0.8485

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FPSO-Pitch
Test913_215_001

Mooring

FPSO-Pitch (deg)

Offset	Average Period	Linear Damping Coefficient	Equivalent Damping Slope	Equivalent Damping Offset
0.0447	9.4834	0.11997	0.84851	-0.04355

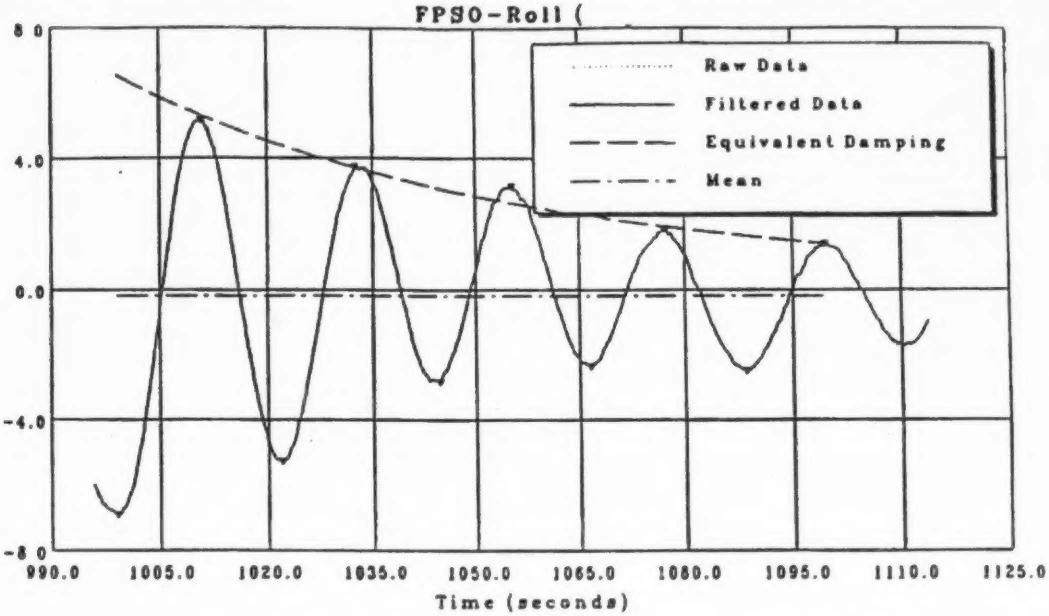
FPSO-Pitch (deg)

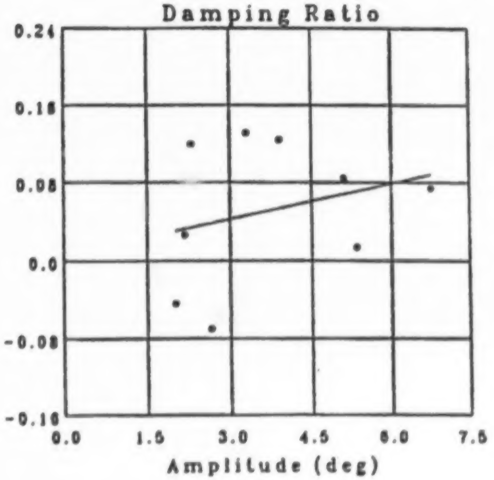
Amplitude	ABS(Amplitude-Offset)	Damping Ratio	Period
-0.2641	0.3088	0.21850	10.2888
0.1976	0.1528	0.08611	8.7885
-0.0717	0.1165	0.05529	8.7914
0.1426	0.0979		10.0651

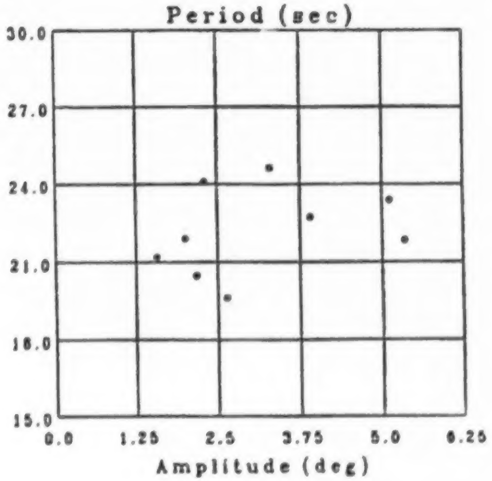
Evacuation Systems

IMD

Analyzed: 29-FEB-2000 12:02:23
Acquired: 11-JAN-2000 21:20:18







MEAN

Offset = -0.1833 deg
Period = 22.20 sec

DAMPING

Linear = 0.05102
Equivalent B1 = 0.005641
Equivalent B2 = 0.01216

National Research Council Canada
Institute for Marine Dynamics

FPSO-Roll
Test913 214 001

FPSO-Roll (deg)

Offset	Average Period	Linear Damping Coefficient	Equivalent Damping Slope	Equivalent Damping Offset
.33	22.1965	0.05102	0.01216	0.00564

FPSO-Roll (deg)

Amplitude	ABS(Amplitude-Offset)	Damping Ratio	Period
-6.9428	6.7594	0.07455	
5.1612	5.3445	0.01387	21.8275
-5.3000	5.1166	0.08437	23.3873
3.7382	3.9215	0.12383	22.7058
-2.8330	2.6497	-0.07028	19.6016
3.1228	3.3062	0.13103	24.6287
-2.3660	2.1827	0.02630	20.4482
1.8262	2.0095	-0.04419	21.9067
-2.4924	2.3090	0.11971	24.0779
1.3976	1.5809		21.1843

Appendix 9 Analyzed Test Results for Individual Experiments

400 Series – TEMPSC Deployment

FPSO Ballast Load, Intact, Heading 20°, Calm Water

Test 913_400_001
Calm Water

The elapsed time between the start of deployment and TEMPSC splashdown is 5.7 seconds. The aft davit falls release 0.5 seconds after splashdown. The forward falls do not release until 3.2 seconds after splashdown. The TEMPSC moves in a perpendicular direction away from the FPSO.

Overall the TEMPSC was delivered smoothly to the water with a clean release of the aft davit falls, however the forward release did not disengage until the TEMPSC was some distance front the FPSO.

Test 913_400_002
Calm Water

The elapsed time between the start of deployment and TEMPSC splashdown is 6.1 seconds. Both davit releases disengage 0.7 seconds after splashdown. The TEMPSC then moves away from the FPSO in a perpendicular direction.

Overall the TEMPSC was delivered smoothly to the water with a clean release from the davit falls both forward and aft.

Test 913_400_003
Calm Water

The elapsed time between the start of deployment and TEMPSC splashdown is 5.8 seconds. Both davit releases disengage 0.4 seconds after splashdown. The TEMPSC then moves away from the FPSO in a perpendicular direction.

Overall the TEMPSC was delivered smoothly to the water with a clean release from the davit falls both forward and aft. However, the model appears to move away from the FPSO more quickly than the first two runs.

Test 913_400_004
Calm Water

The elapsed time between the start of deployment and TEMPSC splashdown is 5.7 seconds. The aft davit falls release 1.1 seconds after splashdown. The forward falls do not release until 2.6 seconds after splashdown. The TEMPSC moves in a perpendicular direction away from the FPSO.

Overall the TEMPSC was delivered smoothly to the water, however the davit falls failed to release until the TEMPSC had moved a short distance from the FPSO.

Test 913_400_005
Calm Water

The elapsed time between the start of deployment and TEMPSC splashdown is 5.8 seconds. The aft davit falls release 2.1 seconds after splashdown. The forward falls do not release until 3.1 seconds after splashdown. Before the davits release the model is pulled to a sudden stop. The TEMPSC then moves in a perpendicular direction away from the FPSO.

Overall the TEMPSC was delivered smoothly to the water, however the davit falls failed to release until the TEMPSC had moved a short distance from the FPSO. In doing so the davit lines actually halted the TEMPSC's progress, stopping it suddenly.

Test 913_400_006
Calm Water

The elapsed time between the start of deployment and TEMPSC splashdown is 5.4 seconds. The aft davit falls release 0.5 seconds after splashdown. The forward falls do not release until 1.8 seconds after splashdown. The TEMPSC then moves in a perpendicular direction away from the FPSO.

Overall the TEMPSC was delivered smoothly to the water, with only a short delay between aft davit fall release and forward davit fall release.

Test 913_400_007
Calm Water

The elapsed time between the start of deployment and TEMPSC splashdown is 5.6 seconds. The aft davit falls release 1.7 seconds after splashdown. The forward falls release at 1.8 seconds after splashdown. The TEMPSC then moves in a perpendicular direction away from the FPSO.

Overall the TEMPSC was delivered smoothly to the water.

Test 913_400_008
Calm Water

The elapsed time between the start of deployment and TEMPSC splashdown is 5.6 seconds. The aft davit falls release 1.0 seconds after splashdown. The forward falls release at 1.9 seconds after splashdown. The TEMPSC then moves in a parallel direction away from the FPSO.

Overall the TEMPSC was delivered smoothly to the water.

Test 913_400_009
Calm Water

The elapsed time between the start of deployment and TEMPSC splashdown is 5.6 seconds. Both the aft and forward davit falls release 1.8 seconds after splashdown. The TEMPSC then moves in a parallel direction away from the FPSO.

Overall the TEMPSC was delivered smoothly to the water.

Test 913_400_010
Calm Water

The elapsed time between the start of deployment and TEMPSC splashdown is 5.6 seconds. The aft davit falls release 1.2 seconds after splashdown. The forward falls release at 1.9 seconds after splashdown. The TEMPSC then moves in a parallel direction away from the FPSO.

Overall the TEMPSC was delivered smoothly to the water with a clean release.

Test 913_400_011
Calm Water

The elapsed time between the start of deployment and TEMPSC splashdown is 5.6 seconds. Both the aft and forward davit falls release 1.8 seconds after splashdown. The TEMPSC then moves in a parallel direction away from the FPSO.

Overall the TEMPSC was delivered smoothly to the water. However, the davits only released after the TEMPSC had moved some distance from the FPSO.

Test 913_400_012

Calm Water

The elapsed time between the start of deployment and TEMPSC splashdown is 5.5 seconds. The aft davit falls release 0.7 seconds after splashdown. The forward falls release at 1.75 seconds after splashdown. The TEMPSC then moves in a parallel direction away from the FPSO.

Overall the TEMPSC was delivered smoothly to the water. However, the forward davit only released after the TEMPSC had moved some distance from the FPSO.

Test 913_400_013
Calm Water

The elapsed time between the start of deployment and TEMPSC splashdown is 5.6 seconds. Both the aft and forward davit falls release 1.7 seconds after splashdown. The TEMPSC then moves in a parallel direction away from the FPSO.

Overall the TEMPSC was delivered smoothly to the water. However, the davits only released after the TEMPSC had moved some distance from the FPSO.

Test 913_400_014
Calm Water

The elapsed time between the start of deployment and TEMPSC splashdown is 5.6 seconds. Both the aft and forward davit falls release 1.7 seconds after splashdown. The TEMPSC then moves in a parallel direction away from the FPSO.

Overall the TEMPSC was delivered smoothly to the water. However, the davits only released after the TEMPSC had moved some distance from the FPSO.

Test 913_400_015
Calm Water

The elapsed time between the start of deployment and TEMPSC splashdown is 5.6 seconds. Both the aft and forward davit falls release 1.7 seconds after splashdown. The TEMPSC then moves in a perpendicular direction away from the FPSO.

Overall the TEMPSC was delivered smoothly to the water. However, the davits only released after the TEMPSC had moved some distance from the FPSO.

Test 913_400_016
Calm Water

The elapsed time between the start of deployment and TEMPSC splashdown is 5.6 seconds. The forward davit falls release 1.0 seconds after splashdown. The aft davit falls release at 1.75 seconds after splashdown. The TEMPSC then moves in a parallel direction away from the FPSO.

Overall the TEMPSC was delivered smoothly to the water. This run however was different then the preceding ones, since the forward davit release before the aft davit. There is no indication on the video of why this would have happened.

Test 913_400_017
Calm Water

The elapsed time between the start of deployment and TEMPSC splashdown is 5.6 seconds. Both the aft and forward davit falls release 1.7 seconds after splashdown. The TEMPSC then moves in a parallel direction away from the FPSO.

Overall the TEMPSC was delivered smoothly to the water. However, the davits only released after the TEMPSC had moved some distance from the FPSO.

Test 913_400_018
Calm Water

The elapsed time between the start of deployment and TEMPSC splashdown is 5.6 seconds. In this run the davits release 0.2 seconds before the TEMPSC reaches the splashdown point. The TEMPSC then moves in a parallel direction away from the FPSO.

Overall the TEMPSC was delivered smoothly to the water. However, the early release of the davits caused the TEMPSC to drop a short distance (approx. 1cm).

Test 913_400_019
Calm Water

The elapsed time between the start of deployment and TEMPSC splashdown is 5.6 seconds. The forward davit falls release 0.6 seconds after splashdown. The aft davit falls release at 1.7 seconds after splashdown. The TEMPSC then moves in a parallel direction away from the FPSO.

Overall the TEMPSC was delivered smoothly to the water. Again, this run was different than most, with the forward davit release before the aft davit. Again there is no indication on the video of why this would have happened.

Test 913_400_020
Calm Water

The elapsed time between the start of deployment and TEMPSC splashdown is 5.6 seconds. Both the aft and forward davit falls release 1.5 seconds after splashdown. The TEMPSC then moves in a parallel direction away from the FPSO.

Overall the TEMPSC was delivered smoothly to the water. However, the davits only released after the TEMPSC had moved some distance from the FPSO.

Test 913_400_021
Calm Water

The elapsed time between the start of deployment and TEMPSC splashdown is 5.6 seconds. The aft davit falls release 0.2 seconds after splashdown. The forward falls release at 1.8 seconds after splashdown. The TEMPSC then moves in a parallel direction away from the FPSO.

Overall the TEMPSC was delivered smoothly to the water. However, the forward davit only released after the TEMPSC had moved some distance from the FPSO.

500 Series – TEMPSC Deployment

FPSO Ballast Load, Intact, Heading 20°, 1.01m Wave Condition

Test 913_500_001
1.01m Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 5.5 seconds.

Splashdown Location: Crest

The aft davit falls release 0.6 seconds after splashdown. The forward falls do not release until 1.7 seconds after splashdown. The TEMPSC moves in a parallel direction away from the FPSO.

Overall the TEMPSC was delivered smoothly to the water with a clean release of the aft davit falls, however the forward release did not disengage until the TEMPSC was some distance front the FPSO.

Test 913_500_002
1.01m Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 5.9 seconds.

Splashdown Location: Trough

Both davit falls release 1.8 seconds after splashdown. The TEMPSC moves in a parallel direction away from the FPSO.

Overall the TEMPSC was delivered smoothly to the water with a delayed release of both davit falls.

Test 913_500_003
1.01m Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 5.7 seconds.

Splashdown Location: Crest

Both davit falls release 1.1 seconds after splashdown. The TEMPSC moves in a parallel direction away from the FPSO.

Overall the TEMPSC was delivered smoothly to the water with a delayed release of both davit falls.

Test 913_500_004
1.01m Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 5.6 seconds.

Splashdown Location: Crest

Both davit falls release 1.8 seconds after splashdown. The TEMPSC moves in a parallel direction away from the FPSO.

Overall the TEMPSC was delivered smoothly to the water with a delayed release of both davit falls.

Test 913_500_005
1.01m Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 5.5 seconds.

Splashdown Location: Down Slope

Both davit falls release 1.5 seconds after splashdown. The TEMPSC moves in a parallel direction away from the FPSO.

Overall the TEMPSC was delivered smoothly to the water with a delayed release of both davit falls.

Test 913_500_006
1.01m Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 5.4 seconds.

Splashdown Location: Down Slope

Both davit falls release 2.2 seconds after splashdown. The TEMPSC moves in a parallel direction away from the FPSO.

Overall the TEMPSC was delivered smoothly to the water with a lengthy delay before release of both davit falls.

Test 913_500_007
1.01m Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 5.7 seconds.

Splashdown Location: Up Slope

Both davit falls release 2.0 seconds after splashdown. The TEMPSC moves in a parallel direction away from the FPSO.

Overall the TEMPSC was delivered smoothly to the water with a delay before release of both davit falls.

Test 913_500_008
1.01m Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 5.7 seconds.

Splashdown Location: Up Slope

Both davit falls release 1.7 seconds after splashdown. The TEMPSC moves in a parallel direction away from the FPSO.

Overall the TEMPSC was delivered smoothly to the water with a delay before release of both davit falls.

Test 913_500_009
1.01m Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 5.7 seconds.

Splashdown Location: Up Slope

Both davit falls release 1.7 seconds after splashdown. The TEMPSC moves in a parallel direction away from the FPSO.

Overall the TEMPSC was delivered smoothly to the water with a delay before release of both davit falls.

Test 913_500_010
1.01m Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 5.5 seconds.

Splashdown Location: Down Slope

Both davit falls release 1.9 seconds after splashdown. The TEMPSC moves in a parallel direction away from the FPSO.

Overall the TEMPSC was delivered smoothly to the water with a delay before release of both davit falls.

Test 913_500_011
1.01m Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 5.4 seconds.

Splashdown Location: Down Slope

Both davit falls release 1.9 seconds after splashdown. The TEMPSC moves in a parallel direction away from the FPSO.

Overall the TEMPSC was delivered smoothly to the water with a delay before release of both davit falls.

Test 913_500_012
1.01m Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 5.6 seconds.

Splashdown Location: Down Slope

Both davit falls release 1.7 seconds after splashdown. The TEMPSC moves in a parallel direction away from the FPSO.

Overall the TEMPSC was delivered smoothly to the water with a delay before release of both davit falls.

Test 913_500_013
1.01m Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 5.8 seconds.

Splashdown Location: Up Slope

Both davit falls release 1.6 seconds after splashdown. The TEMPSC moves in a parallel direction away from the FPSO.

Overall the TEMPSC was delivered smoothly to the water with a delay before release of both davit falls.

Test 913_500_014

1.01m Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 5.8 seconds.

Splashdown Location: Up Slope

The forward davit falls release 1.4 seconds after splashdown. The aft davit falls release 1.7 seconds after splashdown. The TEMPSC moves in a parallel direction away from the FPSO.

Overall the TEMPSC was delivered smoothly to the water. The forward davit released from the model before the aft davit. This was probably because of the motions of the model in the waves.

Test 913_500_015

1.01m Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 5.8 seconds.

Splashdown Location: Up Slope

Both davit falls release 1.5 seconds after splashdown. The TEMPSC moves in a parallel direction away from the FPSO.

Overall the TEMPSC was delivered smoothly to the water with a delay before release of both davit falls.

Test 913_500_016

1.01m Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 5.9 seconds.

Splashdown Location: Up Slope

The aft davit falls release 0.8 seconds after splashdown. The forward davit falls release 1.8 seconds after splashdown. The TEMPSC moves in a parallel direction away from the FPSO.

Overall the TEMPSC was delivered smoothly to the water. The aft davit released very quickly after splashdown, while the forward one released 1 second later. This was the first incidence of this during the 500 series.

Test 913_500_017

1.01m Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 5.5 seconds.

Splashdown Location: Crest

The aft davit falls release 0.7 seconds after splashdown. The forward davit falls release 1.6 seconds after splashdown. The TEMPSC moves in a parallel direction away from the FPSO.

Overall the TEMPSC was delivered smoothly to the water. The aft davit released very quickly after splashdown, while the forward davit released 0.9 seconds later.

Test 913_500_018

1.01m Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 5.5 seconds.

Splashdown Location: Crest

The aft davit falls release 0.6 seconds after splashdown. The forward davit falls release 1.8 seconds after splashdown. The TEMPSC moves in a parallel direction away from the FPSO.

Overall the TEMPSC was delivered smoothly to the water. The aft davit released very quickly after splashdown, while the forward davit released 0.9 seconds later.

Test 913_500_019

1.01m Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 5.6 seconds.

Splashdown Location: Crest

The forward davit falls release 1.0 seconds after splashdown. The forward davit falls release 1.3 seconds after splashdown. The TEMPSC moves in a parallel direction away from the FPSO.

Overall the TEMPSC was delivered smoothly to the water. The forward davit released just before the aft davit released.

Test 913_500_020
1.01m Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 5.9 seconds.

Splashdown Location: Up Slope

Both davit falls release 2.0 seconds after splashdown. The TEMPSC moves in a parallel direction away from the FPSO.

Overall the TEMPSC was delivered smoothly to the water with both davit falls releasing after the TEMPSC had moved a distance from the splashdown point.

Test 913_500_021
1.01m Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 5.4 seconds.

Splashdown Location: Crest

The aft davit falls release 1.1 seconds after splashdown. The forward davit falls release 1.7 seconds after splashdown. The TEMPSC moves in a parallel direction away from the FPSO.

Overall the TEMPSC was delivered smoothly to the water with both davit falls releasing after the TEMPSC had moved a distance from the splashdown point.

525 Series – TEMPSC Deployment

FPSO Ballast Load, Intact, Heading 20°, 2.10m Wave Condition

Test 913_525_001
2.10m Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 5.8 seconds.

Splashdown Location: Crest

The aft davit falls release 0.4 seconds after splashdown. The forward falls do not release until 1.7 seconds after splashdown. The TEMPSC moves in a parallel direction away from the FPSO.

Overall the TEMPSC was delivered smoothly to the water with a clean release of the aft davit falls, however the forward release did not disengage until the TEMPSC was some distance front the FPSO.

Test 913_525_002
2.10m Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 6.0 seconds.

Splashdown Location: Up Slope

Both davit falls release 2.0 seconds after splashdown. The TEMPSC moves in a parallel direction away from the FPSO.

Overall the TEMPSC was delivered smoothly to the water with a clean release of both davits after the TEMPSC had moved a short distance from the splashdown point.

Test 913_525_003
2.10m Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 5.7 seconds.

Splashdown Location: Crest

Both davit falls release 1.9 seconds after splashdown. The TEMPSC moves in a parallel direction away from the FPSO.

Overall the TEMPSC was delivered smoothly to the water with a clean release of both davits after the TEMPSC had moved a short distance from the splashdown point.

Test 913_525_004
2.10m Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 6.0 seconds.

Splashdown Location: Trough

Both davit falls release 1.9 seconds after splashdown. The TEMPSC moves in a parallel direction away from the FPSO.

Overall the TEMPSC was delivered smoothly to the water with a clean release of both davits after the TEMPSC had moved a short distance from the splashdown point.

Test 913_525_005
2.10m Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 5.6 seconds.

Splashdown Location: Crest

Both davit falls release 1.6 seconds after splashdown. The TEMPSC moves in a parallel direction away from the FPSO.

Overall the TEMPSC was delivered smoothly to the water with a clean release of both davits after the TEMPSC had moved a short distance from the splashdown point.

Test 913_525_006
2.10m Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 6.0 seconds.

Splashdown Location: Up Slope

The aft davit falls release 0.1 seconds after splashdown. The forward falls do not release until 1.9 seconds after splashdown. The TEMPSC moves in a parallel direction away from the FPSO.

Overall the TEMPSC was delivered smoothly to the water with a clean release of the aft davit falls immediately and the forward davits falls releasing after the TEMPSC had moved a short distance from the splashdown point.

Test 913_525_007
2.10m Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 6.1 seconds.

Splashdown Location: Trough

Both davit falls release 1.9 seconds after splashdown. The TEMPSC moves in a parallel direction away from the FPSO.

Overall the TEMPSC was delivered smoothly to the water with a clean release of both davits after the TEMPSC had moved a short distance from the splashdown point.

Test 913_525_008
2.10m Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 5.8 seconds.

Splashdown Location: Up Slope

Both davit falls release 1.9 seconds after splashdown. The TEMPSC moves in a parallel direction away from the FPSO.

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Overall the TEMPSC was delivered smoothly to the water with a clean release of both davits after the TEMPSC had moved a short distance from the splashdown point.

Test 913_525_009
2.10m Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 5.8 seconds.

Splashdown Location: Up Slope

Both davit falls release 1.9 seconds after splashdown. The TEMPSC moves in a parallel direction away from the FPSO.

Overall the TEMPSC was delivered smoothly to the water with a clean release of both davits after the TEMPSC had moved a short distance from the splashdown point.

Test 913_525_010
2.10m Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 6.2 seconds. However, the TEMPSC did momentarily touch the wave on the down slope at about 5.2 seconds. The TEMPSC was immediately pulled up out of the wave with the upward motion of the FPSO.

Splashdown Location: Trough

Both davit falls release just before (< 0.1 seconds) splashdown. The TEMPSC moves in a parallel direction away from the FPSO.

The TEMPSC was not delivered cleanly to the water. It touched the water and then was pulled upward. This made for an unclean release at the final splashdown point.

Test 913_525_011
2.10m Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 6.2 seconds. However, the TEMPSC did momentarily touch the wave on the crest at about 5.1 seconds. The TEMPSC was immediately pulled up out of the wave with the upward motion of the FPSO.

Splashdown Location: Trough

The aft davit falls release just after (< 0.1 seconds) splashdown. The forward davit falls released at 1.9 seconds after splashdown. The TEMPSC moves in a parallel direction away from the FPSO.

The TEMPSC was not delivered cleanly to the water. It touched the water and then was pulled upward. This made for an unclean release at the final splashdown point.

Test 913_525_012
2.10m Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 6.1 seconds.

Splashdown Location: Up Slope

Both davit falls release just after (< 0.1 seconds) splashdown. The TEMPSC moves in a parallel direction away from the FPSO.

Overall the TEMPSC was delivered smoothly to the water with a very clean release. The TEMPSC did appear to experience a small setback due to the up slope launch.

Test 913_525_013
2.10m Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 5.8 seconds.

Splashdown Location: Crest

Both davit falls release 1.8 seconds after splashdown. The TEMPSC moves in a parallel direction away from the FPSO.

Overall the TEMPSC was delivered cleanly to the water with the release occurring 1.8 seconds after splashdown. There did not appear to be any setback.

Test 913_525_014
2.10m Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 5.4 seconds.

Splashdown Location: Crest

Both davit falls release at 0.4 seconds after splashdown. The TEMPSC moves in an approximate 10° direction away from the FPSO.

Overall the TEMPSC was delivered cleanly to the water with the release occurring very quickly after splashdown. There did not appear to be any setback.

Test 913_525_015
2.10m Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 6.0 seconds.

Splashdown Location: Up Slope

Both davit falls release 0.2 seconds after splashdown. The TEMPSC moves in an approximate 10° direction away from the FPSO.

Overall the TEMPSC was delivered cleanly to the water with the release occurring very quickly after splashdown. There did not appear to be any setback.

Test 913_525_016
2.10m Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 5.7 seconds.

Splashdown Location: Crest

The aft davit falls release 0.7 seconds after splashdown. The forward davit falls release at 1.6 seconds. The TEMPSC moves in a parallel direction away from the FPSO.

Overall the TEMPSC was delivered cleanly to the water with the release occurring very quickly after splashdown. There did not appear to be any setback.

Test 913_525_017
2.10m Wave Condition

No Video.

Test 913_525_018
2.10m Wave Condition

No Video.

Test 913_525_019
2.10m Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 5.8 seconds.

Splashdown Location: Crest

Both davit falls release 0.1 seconds after splashdown. The TEMPSC moves in a parallel direction away from the FPSO.

Overall the TEMPSC was delivered cleanly to the water with the release occurring very quickly after splashdown. There appeared to be a small amount of setback.

Test 913_525_020
2.10m Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 6.1 seconds.

Splashdown Location: Trough

Both davit falls release 0.2 seconds after splashdown. The TEMPSC moves in a parallel direction away from the FPSO.

Overall the TEMPSC was delivered cleanly to the water with the release occurring very quickly after splashdown. There did not appear to be any setback.

Test 913_525_021
2.10m Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 5.7 seconds.

Splashdown Location: Up Slope

The aft davit falls release 0.4 seconds after splashdown. The forward davit falls release at 2.2 seconds. The TEMPSC moves in a parallel direction away from the FPSO.

Overall the TEMPSC was delivered cleanly to the water with the release occurring very quickly after splashdown. There appeared to be a noticeable setback.

Test 913_525_022
2.10m Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 5.3 seconds.

Splashdown Location: Crest

Both davit falls release 0.3 seconds after splashdown. The TEMPSC moves in a parallel direction away from the FPSO.

Overall the TEMPSC was delivered cleanly to the water with the release occurring very quickly after splashdown. There did not appear to be any setback.

Test 913_525_023
2.10m Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 5.4 seconds.

Splashdown Location: Crest

Both davit falls release 0.3 seconds after splashdown. The TEMPSC moves in a parallel direction away from the FPSO.

Overall the TEMPSC was delivered cleanly to the water with the release occurring very quickly after splashdown. There did not appear to be any setback. The forward davit line seemed to catch on the TEMPSC after the release, but it did not seem to hamper the movement of the TEMPSC.

Test 913_525_024
2.10m Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 5.4 seconds.

Splashdown Location: Crest

The forward davit falls release 0.6 seconds after splashdown. The aft davit falls release at 1.2 seconds. The TEMPSC moves in a parallel direction away from the FPSO.

Overall the TEMPSC was delivered cleanly to the water with the release occurring very quickly after splashdown. There did not appear to be any setback.

Test 913_525_025
2.10m Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 5.8 seconds.

Splashdown Location: Up Slope

Both davit falls release 2.0 seconds after splashdown. The TEMPSC moves in a parallel direction away from the FPSO.

Overall the TEMPSC was delivered cleanly to the water with the release occurring a short time after splashdown. There did not appear to be any setback.

550 Series – TEMPSC Deployment

FPSO Ballast Load, Intact, Heading 20°, 3.96m Wave Condition

Test 913_550_001
3.96m Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 6.3 seconds.

Splashdown Location: Trough

Both davit falls release 2.6 seconds after splashdown. The TEMPSC moves in a perpendicular direction away from the FPSO.

Overall the TEMPSC was delivered smoothly to the water. The davits however, did not release until the TEMPSC had moved some distance from the FPSO.

Test 913_550_002
3.96m Wave Condition

The elapsed time between the start of deployment and first TEMPSC splashdown point is 5.3 seconds. After this initial splashdown point the model is lifted from the water due to the motions of the FPSO. The final splashdown occurs at 6.3 seconds after deployment.

Splashdown Location: Trough

After deployment the davits failed to release. This run will be counted as a failed run.

Test 913_550_003
3.96m Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 5.9 seconds.

Splashdown Location: Up Slope

Both davit falls release 2.0 seconds after splashdown. The TEMPSC moves in a parallel direction away from the FPSO.

Overall the TEMPSC was delivered smoothly to the water. The davits however, did not release until the TEMPSC had moved some distance from the FPSO.

Test 913_550_004
3.96m Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 6.0 seconds.

Splashdown Location: Trough

The aft davit falls release 0.4 seconds after splashdown. The forward davit falls release 0.7 seconds after splashdown. The TEMPSC moves in a parallel direction away from the FPSO.

Overall the TEMPSC was delivered smoothly to the water with a clean release. A small setback was also observed. The run log indicates that the battery was low on the TEMPSC, causing a reduction in speed.

Test 913_550_005
3.96m Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 5.8 seconds.

Splashdown Location: Up Slope

Both davit falls release 0.1 seconds after splashdown. The TEMPSC moves in a parallel direction away from the FPSO.

Overall the TEMPSC was delivered smoothly to the water with a clean release. No setback was observed.

Test 913_550_006
3.96m Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 6.1 seconds.

Splashdown Location: Trough

Both davit falls release 0.2 seconds after splashdown. The TEMPSC moves in a parallel direction away from the FPSO.

Overall the TEMPSC was delivered smoothly to the water with a clean release. No setback was observed.

Test 913_550_007
3.96m Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 6.1 seconds.

Splashdown Location: Trough

Both davit falls release < 0.1 seconds after splashdown. The TEMPSC moves in a parallel direction away from the FPSO.

Overall the TEMPSC was delivered smoothly to the water with a clean release. A small amount of setback was observed.

Test 913_550_008
3.96m Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 6.2 seconds.

Splashdown Location: Trough

Both davit falls release < 0.1 seconds after splashdown. The TEMPSC moves in a parallel direction away from the FPSO.

Overall the TEMPSC was delivered smoothly to the water with a clean release. Some setback was observed as the TEMPSC proceeded up the wave slope.

Test 913_550_009
3.96m Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 5.5 seconds.

Splashdown Location: Up Slope

Both davit falls release 0.7 seconds after splashdown. The TEMPSC moves in a parallel direction away from the FPSO.

Overall the TEMPSC was delivered smoothly to the water with a clean release. No setback was observed. Conversely, the TEMPSC appeared to surf down the wave after release.

Test 913_550_010
3.96m Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 6.1 seconds.

Splashdown Location: Trough

The aft davit falls release 0.3 seconds after splashdown. The forward davit falls release 2.6 seconds after splashdown. The TEMPSC moves in a parallel direction away from the FPSO.

Overall the TEMPSC was delivered smoothly to the water with a clean release on the aft davit. The forward davit did not release until the TEMPSC had moved away from the FPSO. There was a fair amount of setback observed.

Test 913_550_011
3.96m Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 5.5 seconds.

Splashdown Location: Crest

The aft davit falls release 0.4 seconds after splashdown. The forward davit falls release 2.6 seconds after splashdown. The TEMPSC moves in a parallel direction away from the FPSO.

Overall the TEMPSC was delivered smoothly to the water with a clean release. There was no setback observed.

Test 913_550_012
3.96m Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 5.9 seconds.

Splashdown Location: Trough

Both davit falls release 2.1 seconds after splashdown. The TEMPSC moves in a parallel direction away from the FPSO.

Overall the TEMPSC was delivered smoothly to the water with a late release from the davits. There was a small setback observed.

Test 913_550_013
3.96m Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 5.4 seconds.

Splashdown Location: Crest

Both davit falls release < 0.1 seconds after splashdown. The TEMPSC moves in a parallel direction away from the FPSO.

Overall the TEMPSC was delivered smoothly to the water with a very clean release from the davits. There was no setback observed.

Test 913_550_014

3.96m Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 6.1 seconds.

Splashdown Location: Trough

The forward davit falls release 1.5 seconds after splashdown. The aft davit falls release 2.8 seconds after splashdown. The TEMPSC moves in a parallel direction away from the FPSO.

Overall the TEMPSC was delivered smoothly to the water with a very clean release from the forward davit but a delay in the release of the aft davit. There was no setback observed.

Test 913_550_015

3.96m Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 5.5 seconds.

Splashdown Location: Up Slope

Both davit falls release 0.5 seconds after splashdown. The TEMPSC moves in a parallel direction away from the FPSO.

Overall the TEMPSC was delivered smoothly to the water with a very clean release. There was no setback observed. Conversely, the TEMPSC appeared to surf down the wave.

Test 913_550_016

3.96m Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 5.8 seconds.

Splashdown Location: Up Slope

Both davit falls release 2.5 seconds after splashdown. The TEMPSC moves in a parallel direction away from the FPSO.

Overall the TEMPSC was delivered smoothly to the water with a delayed release. There was no setback observed.

Test 913_550_017

3.96m Wave Condition

Failed test.

Test 913_550_018
3.96m Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 5.8 seconds.

Splashdown Location: Up Slope

Both davit falls release 0.1 seconds after splashdown. The TEMPSC moves in a parallel direction away from the FPSO.

Overall the TEMPSC was delivered smoothly to the water with a clean release. There was no setback observed.

Test 913_550_019
3.96m Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 5.3 seconds.

Splashdown Location: Crest

Both davit falls release < 0.1 seconds after splashdown. The TEMPSC moves in a parallel direction away from the FPSO.

Overall the TEMPSC was delivered smoothly to the water with a very clean release. There was no setback observed.

Test 913_550_020
3.96m Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 5.9 seconds.

Splashdown Location: Trough

Both davit falls release < 0.3 seconds after splashdown. The TEMPSC moves in a parallel direction away from the FPSO.

Overall the TEMPSC was delivered smoothly to the water with a very clean release. There was no setback observed.

Test 913_550_021
3.96m Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 5.2 seconds.

Splashdown Location: Crest

The aft davit falls release 0.2 seconds after splashdown. The forward davit falls do not release until 1.0 seconds after splashdown. The TEMPSC moves in a parallel direction away from the FPSO.

Overall the TEMPSC was delivered smoothly to the water. The release however, was not clean. The aft davit released quickly, but the forward davit did not release cleanly. This resulted in the davit line pulling up on the TEMPSC, lifting the bow out of the water momentarily. This pulling effect nullified any possible setback.

Test 913_550_022
3.96m Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 5.8 seconds.

Splashdown Location: Trough

The aft davit falls release 0.5 seconds after splashdown. The forward davit falls do not release until 2.4 seconds after splashdown. The TEMPSC moves in a parallel direction away from the FPSO.

Overall the TEMPSC was delivered smoothly to the water with a clean release on the aft davit. The forward davit did not release until the TEMPSC had moved some distance from the splashdown point. There was a small setback observed.

Test 913_550_023
3.96m Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 5.4 seconds.

Splashdown Location: Crest

Both davit falls release < 0.1 seconds after splashdown. The TEMPSC moves in a parallel direction away from the FPSO.

Overall the TEMPSC was delivered smoothly to the water with a clean release on the davits. There was no setback observed. Conversely, the TEMPSC surfed down the wave.

Test 913_550_024
3.96m Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 5.4 seconds.

Splashdown Location: Crest

Both davit falls release < 0.1 seconds after splashdown. The TEMPSC moves in a parallel direction away from the FPSO.

Overall the TEMPSC was delivered smoothly to the water with a clean release on the davits. There was no setback observed. Conversely, the TEMPSC surfed down the wave.

Test 913_550_025
3.96m Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 5.9 seconds.

Splashdown Location: Crest

Both davit falls release 0.1 seconds after splashdown. The TEMPSC moves in a parallel direction away from the FPSO.

Overall the TEMPSC was delivered smoothly to the water with a clean release on the davits. There was no setback observed.

600 Series – TEMPSC Deployment

FPSO Ballast Load, Intact, Heading 20°, 6.71m Wave Condition

Test 913_600_001
6.71m Wave Condition

The elapsed time between the start of deployment and first TEMPSC splashdown is 4.9 seconds. At this point though the TEMPSC is not released and is pulled out of the water 0.7 seconds later. The TEMPSC then hits a second splashdown 1.0 seconds later. Total time to second splashdown is 6.6 seconds.

First Splashdown Location: Up Slope

Second Splashdown Location: Trough

Both davit falls release 0.1 seconds after final splashdown. The TEMPSC moves in a 20° direction away from the FPSO without many problems.

In this run the davits were not released at the first splashdown, causing the TEMPSC to be pulled out of the water by the upward motion of the FPSO.

Test 913_600_002

6.71m Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 5.5 seconds.

Splashdown Location: Up Slope

Both davit falls release 0.1 seconds after final splashdown. The TEMPSC moves in a 60° direction from the FPSO without many problems.

Overall the TEMPSC was deployed smoothly to the water with a very clean release. No setback was observed.

Test 913_600_003

6.71m Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 5.4 seconds.

Splashdown Location: Up Slope

Both davit falls release 0.1 seconds after splashdown. The TEMPSC moves in a 50° direction away from the FPSO without many problems.

Overall the TEMPSC was deployed smoothly to the water with a very clean release. There was a very small amount of setback observed.

Test 913_600_004

6.71m Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 5.2 seconds.

Splashdown Location: Trough

Both davit falls release 0.3 seconds after splashdown. The TEMPSC moves in a parallel away from the FPSO without many problems.

Overall the TEMPSC was deployed smoothly to the water with a very clean release. No setback was observed.

Test 913_600_005

6.71m Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 5.5 seconds.

Splashdown Location: Up Slope

Both davit falls release 0.3 seconds after splashdown. The TEMPSC moves in a 45° away from the FPSO without many problems.

Overall the TEMPSC was deployed smoothly to the water with a very clean release. No setback was observed.

Test 913_600_006

6.71m Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 5.0 seconds.

Splashdown Location: Up Slope

Both davit falls release 0.4 seconds after splashdown. The TEMPSC moves in a 40° direction away from the FPSO without problems.

Overall the TEMPSC was deployed smoothly to the water with a very clean release. No setback was observed.

Test 913_600_007

6.71m Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 5.7 seconds.

Splashdown Location: Up Slope

Both davit falls release 0.6 seconds after splashdown. The TEMPSC moves in a 50° direction away from the FPSO without problems.

Overall the TEMPSC was deployed smoothly to the water with a clean release. No setback was observed.

Test 913_600_008

6.71m Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 4.9 seconds.

Splashdown Location: Up Slope

Both davit falls release 0.5 seconds after splashdown. The TEMPSC moves in a 60° direction away from the FPSO without problems.

Overall the TEMPSC was deployed smoothly to the water with a clean release. No setback was observed. The motion of the FPSO accelerated the splashdown during this run. Just as the TEMPSC was about to reach the water the FPSO started a downward heave. This heave motion made the TEMPSC appear to free fall to the water.

Test 913_600_009
6.71m Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 5.8 seconds.

Splashdown Location: Trough

Both davit falls release 1.4 seconds after splashdown. The TEMPSC moves in a 45° direction away from the FPSO without problems.

Overall the TEMPSC was deployed smoothly to the water with a clean release. No setback was observed. Again, the motion of the FPSO accelerated the splashdown during this run. Just as the TEMPSC was about to reach the water the FPSO started a downward heave. This heave motion made the TEMPSC appear to free fall to the water.

Test 913_600_010
6.71m Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 5.9 seconds.

Splashdown Location: Trough

Both davit falls release 0.2 seconds after final splashdown. The TEMPSC moves in a 35° direction away from the FPSO without problems.

Overall the TEMPSC was deployed smoothly to the water with a clean release. No setback was observed. As previously, the motion of the FPSO accelerated the splashdown during this run. Just as the TEMPSC was about to reach the water the FPSO started a downward heave. This heave motion made the TEMPSC appear to free fall to the water.

Test 913_600_011
6.71m Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 5.1 seconds.

Splashdown Location: Up Slope

Both davit falls release 0.2 seconds after final splashdown. The TEMPSC moves in a 55° direction away from the FPSO without problems.

Overall the TEMPSC was deployed smoothly to the water with a clean release. No setback was observed. During this run the FPSO was beginning an upward heave motion which seemed to dampen the accelerations that the TEMPSC would experience.

Test 913_600_012

6.71m Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 5.3 seconds.

Splashdown Location: Up Slope

Both davit falls release 0.4 seconds after final splashdown. The TEMPSC moves in a 45° direction away from the FPSO without problems.

Overall the TEMPSC was deployed smoothly to the water with a clean release. No setback observed. As previously, the motion of the FPSO accelerated the splashdown during this run. Just as the TEMPSC was about to reach the water the FPSO was at the end of a downward heave.

Test 913_600_013

6.71m Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 4.8 seconds.

Splashdown Location: Up Slope

Both davit falls release 0.5 seconds after final splashdown. The TEMPSC moves in a 50° direction away from the FPSO without problems.

Overall the TEMPSC was deployed smoothly to the water with a clean release. There was no setback observed. As previously, the motion of the FPSO accelerated the splashdown during this run. Just as the TEMPSC was about to reach the water the FPSO was at the end of a downward heave.

Test 913_600_014

6.71m Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 5.0 seconds.

Splashdown Location: Up Slope

Both davit falls release 0.1 seconds after final splashdown. The TEMPSC moves in a 40° direction away from the FPSO without problems.

Overall the TEMPSC was deployed smoothly to the water with a clean release. There was no setback observed. As previously, the motion of the FPSO accelerated the splashdown during this run. Just as the TEMPSC was about to reach the water the FPSO was at the end of a downward heave.

Test 913_600_015
6.71m Wave Condition

TEMPSC failed to release.

Test 913_600_016
6.71m Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 5.1 seconds.

Splashdown Location: Up Slope

The aft davit falls release 0.2 seconds after splashdown. The forward davit falls release 0.8 seconds after splashdown. The TEMPSC moves in a 40° direction away from the FPSO without problems.

Overall the TEMPSC was deployed smoothly to the water with a clean release. The forward davit did not release until the line became tight. There was a very small setback observed. As previously, the motion of the FPSO accelerated the splashdown during this run. Just as the TEMPSC was about to reach the water the FPSO was at the end of a downward heave.

Test 913_600_017
6.71m Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 5.5 seconds.

Splashdown Location: Up Slope

Both davit falls release 1.3 seconds after splashdown. The TEMPSC moves in a 45° direction away from the FPSO without problems.

Overall the TEMPSC was deployed smoothly to the water with a clean release. There was a very small setback observed. As previously, the motion of the FPSO accelerated the splashdown during this run.

Test 913_600_018
6.71m Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 5.1 seconds.

Splashdown Location: Up Slope

Both davit falls release 0.4 seconds after splashdown. The TEMPSC moves in a 50° direction away from the FPSO without problems.

Overall the TEMPSC was deployed smoothly to the water with a clean release. There was no setback observed. As previously, the motion of the FPSO accelerated the splashdown during this run.

Test 913_600_019
6.71m Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 5.3 seconds.

Splashdown Location: Up Slope

Both davit falls release 0.5 seconds after final splashdown. The TEMPSC moves in a 40° direction away from the FPSO without problems.

Overall the TEMPSC was deployed smoothly to the water with a clean release. There was a substantial amount of setback observed. As previously, the motion of the FPSO accelerated the splashdown during this run.

Test 913_600_020
6.71m Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 4.7 seconds.

Splashdown Location: Up Slope

Both davit falls release 0.3 seconds after splashdown. The TEMPSC moves in a 60° direction away from the FPSO without problems.

Overall the TEMPSC was deployed smoothly to the water with a clean release. There was some setback observed. As previously, the motion of the FPSO accelerated the splashdown during this run.

Test 913_600_021
6.71m Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 4.8 seconds.

Splashdown Location: Up Slope

Both davit falls release 0.9 seconds after splashdown. The TEMPSC moves in a 50° direction away from the FPSO without problems.

Overall the TEMPSC was deployed smoothly to the water with a clean release. There was a very small amount of setback observed. As previously, the motion of the FPSO accelerated the splashdown during this run.

Test 913_600_022

6.71m Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 5.1 seconds.

Splashdown Location: Up Slope

Both davit falls release 0.3 seconds after splashdown. The TEMPSC moves in a 70° direction away from the FPSO without problems.

Overall the TEMPSC was deployed smoothly to the water with a clean release. There was some setback observed. As previously, the motion of the FPSO accelerated the splashdown during this run.

625 Series – TEMPSC Deployment

FPSO Ballast Load, TC Demo, Intact, Heading 20°, 11.23m Wave Condition

Notes: For all runs the TEMPSC oscillated from side to side due to the large FPSO heave motions.

Test 913_625_001

11.23m Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 5.2 seconds.

Splashdown Location: Trough

Both davit falls release 1.0 seconds after splashdown. The TEMPSC moves in a perpendicular direction away from the FPSO.

Overall the TEMPSC was delivered cleanly to the water with a smooth release. The only thing to note is that the TEMPSC "slid back" down the up slope of the wave (setback say about 1 boat length), and that the lifeboat moved perpendicularly away from the FPSO due to a hard to starboard rudder command.

Test 913_625_002

11.23m Wave Condition

No data for this run.

Test 913_625_003

11.23m Wave Condition

Video labeled incorrectly (Test913_625_002). TEMPSC failed to release, no valid data.

Test 913_625_004
11.23m Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 4.6 seconds.

Splashdown Location: Up Slope

Both davit falls release 0.8 seconds after splashdown. The TEMPSC moves in a 50° direction away from the FPSO.

Overall the TEMPSC was delivered cleanly to the water with a smooth release. There was a great deal of setback observed (1 boat length), as the TEMPSC could not build up enough momentum to overcome the up slope of the wave.

Test 913_625_005
11.23m Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 5.3 seconds.

Splashdown Location: Trough

Both davit falls release 0.5 seconds after splashdown. The TEMPSC moves in a 90° direction away from the FPSO.

Overall the TEMPSC was delivered cleanly to the water with a smooth release. There was only a moderate amount of setback (1/3 of a boat length) observed for this run.

Test 913_625_006
11.23m Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 4.6 seconds.

Splashdown Location: Up Slope

Both davit falls release 0.2 seconds after splashdown. The TEMPSC moves in a 90° direction away from the FPSO.

Overall the TEMPSC was delivered cleanly to the water with a smooth release. There was a great deal of setback observed (1 boat length) for this run.

Test 913_625_007
11.23m Wave Condition

TEMPSC failed to release, no valid data.

Test 913_625_008
11.23m Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 5.7 seconds.

Splashdown Location: Trough

Both davit falls release 0.1 seconds after splashdown. The TEMPSC moves in a 45° direction away from the FPSO.

Overall the TEMPSC was delivered cleanly to the water with a smooth release. There was very little setback observed for this run.

Test 913_625_009
11.23m Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 5.7 seconds.

Splashdown Location: Trough

Both davit falls release 0.1 seconds after splashdown. The TEMPSC moves in a 50° direction away from the FPSO.

Overall the TEMPSC was delivered cleanly to the water with a smooth release. There was a great deal of setback observed (1.5 boat lengths) for this run.

Test 913_625_010
11.23m Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 5.7 seconds.

Splashdown Location: Trough

The forward davit falls release 0.3 seconds after splashdown. The aft davit falls release 1.1 seconds after splashdown. The TEMPSC moves in a 50° direction away from the FPSO.

Overall the TEMPSC was delivered cleanly to the water with a smooth release. There was no setback observed for this run.

Test 913_625_011
11.23m Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 4.9 seconds.

Splashdown Location: Up Slope

Both davit falls release 0.3 seconds after splashdown. The TEMPSC moves in a 60° direction away from the FPSO.

Overall the TEMPSC was delivered cleanly to the water with a smooth release. There was a 1-boat length setback observed for this run.

Test 913_625_012
11.23m Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 4.9 seconds.

Splashdown Location: Up Slope

Both davit falls release 0.1 seconds after splashdown. The TEMPSC moves in a 70° direction away from the FPSO.

Overall the TEMPSC was delivered cleanly to the water with a smooth release. There was a 1-boat length setback observed for this run.

Test 913_625_013
11.23m Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 5.8 seconds.

Splashdown Location: Trough

Both davit falls release 0.3 seconds after splashdown. The TEMPSC moves in a 45° direction away from the FPSO.

Overall the TEMPSC was delivered cleanly to the water with a smooth release. There was no setback observed for this run.

Test 913_625_014
11.23m Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 5.0 seconds.

Splashdown Location: Trough

Both davit falls release 0.2 seconds after splashdown. The TEMPSC moves in a 60° direction away from the FPSO.

Overall the TEMPSC was delivered cleanly to the water with a smooth release. There was a 1-boat length setback observed for this run.

Test 913_625_015
11.23m Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 5.2 seconds.

Splashdown Location: Up Slope

Both davit falls release 0.4 seconds after splashdown. The TEMPSC moves in a 75° direction away from the FPSO.

Overall the TEMPSC was delivered cleanly to the water with a smooth release. There was a 1-boat length setback observed for this run.

Test 913_625_016
11.23m Wave Condition

TEMPSC failed to release, no valid data.

Test 913_625_017
11.23m Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 4.9 seconds.

Splashdown Location: Trough

Both davit falls release 0.1 seconds after splashdown. The TEMPSC moves in a 60° direction away from the FPSO.

Overall the TEMPSC was delivered cleanly to the water with a smooth release. There was a 1/2 boat length setback observed for this run.

Test 913_625_018
11.23m Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 5.3 seconds.

Splashdown Location: Trough

Both davit falls release 0.2 seconds after splashdown. The TEMPSC moves in a 48° direction away from the FPSO.

Overall the TEMPSC was delivered cleanly to the water with a smooth release. There was a 1/2 boat length setback observed for this run.

Test 913_625_019
11.23m Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 5.6 seconds.

Splashdown Location: Trough

Both davit falls release 0.7 seconds after splashdown. The TEMPSC moves in a 50° direction away from the FPSO.

Overall the TEMPSC was delivered cleanly to the water with a smooth release. There was no setback observed for this run.

Test 913_625_020
11.23m Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 5.0 seconds.

Splashdown Location: Trough

Both davit falls release 0.3 seconds after splashdown. The TEMPSC moves in a 70° direction away from the FPSO.

Overall the TEMPSC was delivered cleanly to the water with a smooth release. There was a 1-boat length setback observed for this run.

Test 913_625_021
11.23m Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 5.0 seconds.

Splashdown Location: Up Slope

Both davit falls release 0.2 seconds after splashdown. The TEMPSC moves in a 70° direction away from the FPSO.

Overall the TEMPSC was delivered cleanly to the water with a smooth release. There was a 1.3-boat length setback observed for this run.

Test 913_625_022
11.23m Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 4.7 seconds.

Splashdown Location: Up Slope

Both davit falls release 0.2 seconds after splashdown. The TEMPSC moves in a 70° direction away from the FPSO.

Overall the TEMPSC was delivered cleanly to the water with a smooth release. There was a 1-boat length setback observed for this run.

Test 913_625_023
11.23m Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 5.6 seconds.

Splashdown Location: Trough

Both davit falls release 0.1 seconds after splashdown. The TEMPSC moves in a 80° direction away from the FPSO.

Overall the TEMPSC was delivered cleanly to the water with a smooth release. There was a 1/2 boat length setback observed for this run.

Test 913_625_024
11.23m Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 5.5 seconds.

Splashdown Location: Trough

The forward davit falls release 0.6 seconds after splashdown. The aft davit falls release 1.0 seconds after splashdown. The TEMPSC moves in a 70° direction away from the FPSO.

Overall the TEMPSC was delivered cleanly to the water with a smooth release. There was no setback observed for this run.

700 Series – TEMPSC Deployment

FPSO Ballast Load, Intact, Heading 20°, Enhanced Deployment, Calm Water

Test 913_700_001
Calm Water

The elapsed time between the start of deployment and TEMPSC splashdown is 5.6 seconds. The aft davit falls release < 0.1 seconds after splashdown. The forward falls do not release until 1.4 seconds after splashdown. The TEMPSC moves in a 45° direction away from the FPSO. The PRoD system pulls the TEMPSC on a 45° angle with the tagline releasing 1.4 seconds after splashdown.

Overall the TEMPSC was delivered cleanly to the water with a smooth release of the aft davit and a delayed release of the forward davit line. The PRoD boom at splashdown was deflected minimally below the PRoD baseline.

Test 913_700_002
Calm Water

The elapsed time between the start of deployment and TEMPSC splashdown is 5.6 seconds. The aft davit falls release 0.2 seconds after splashdown. The forward falls do not release until 1.4 seconds after splashdown. The TEMPSC moves in a 45° direction away from the FPSO. The PRoD system pulls the TEMPSC on a 45° angle with the tagline releasing 1.4 seconds after splashdown.

Overall the TEMPSC was delivered cleanly to the water with a smooth release of the aft davit and a delayed release of the forward davit line. The PRoD boom at splashdown was deflected minimally below the PRoD baseline.

Test 913_700_003
Calm Water

The elapsed time between the start of deployment and TEMPSC splashdown is 5.4 seconds. Both davit falls release 1.3 seconds after splashdown. The TEMPSC moves in a 45° direction away from the FPSO. The PRoD system pulls the TEMPSC on a 45° angle with the tagline releasing 1.3 seconds after splashdown.

Overall the TEMPSC was delivered cleanly to the water with a delayed release of both davit lines. The PRoD boom at splashdown was deflected minimally below the PRoD baseline.

Test 913_700_004
Calm Water

Failed run, davit and PRoD lines did not release.

Test 913_700_005
Calm Water

The elapsed time between the start of deployment and TEMPSC splashdown is 5.4 seconds. Both davit falls release 0.4 seconds after splashdown. The TEMPSC moves in a 45° direction away from the FPSO. The PRoD system pulls the TEMPSC on a 45° angle with the tagline releasing 1.5 seconds after splashdown.

Overall the TEMPSC was delivered cleanly to the water with a delayed release of both davit lines. The PRoD boom at splashdown was deflected minimally below the PRoD baseline.

Test 913_700_006
Calm Water

The elapsed time between the start of deployment and TEMPSC splashdown is 5.4 seconds. Both davit falls release 0.4 seconds after splashdown. The TEMPSC moves in a 45° direction away from the FPSO. The PRoD system pulls the TEMPSC on a 45° angle with the tagline releasing 1.5 seconds after splashdown.

Overall the TEMPSC was delivered cleanly to the water with a smooth release of both the davit falls and the ProD. The PRoD boom at splashdown was deflected 1 boat height below the PRoD baseline. The boom appeared to be very effective in pulling the TEMPSC away from the FPSO.

725 Series – TEMPSC Deployment

FPSO Ballast Load, Intact, Heading 20°, Enhanced Deployment, 2.10m Wave Condition

Test 913_725_001
2.10m Wave Condition

Failed run.

Test 913_725_002
2.10m Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 5.6 seconds.

Splashdown Location: Crest

The forward davit falls release 0.2 seconds after splashdown. The aft davit falls release 0.8 seconds after splashdown. After splashdown the PRoD boom pulls the TEMPSC in a 45° direction before it releases 1.7 seconds later. The TEMPSC then continues to move in a 45° direction away from the FPSO.

Overall the TEMPSC was delivered cleanly to the water with a smooth release of both the davit falls and the ProD. The PRoD boom at splashdown was deflected minimally below the PRoD baseline.

Test 913_725_003
2.10m Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 5.2 seconds.

Splashdown Location: Crest

Both davit falls release < 0.1 seconds after splashdown. After splashdown the PRoD boom pulls the TEMPSC in a 45° direction before it releases 1.5 seconds later. The TEMPSC then continues to move in a 50° direction away from the FPSO.

Overall the TEMPSC was delivered cleanly to the water with a smooth release of both the davit falls and the ProD. The PRoD boom at splashdown was deflected minimally below the PRoD baseline.

Test 913_725_004
2.10m Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 6.5 seconds.

Splashdown Location: Crest

The aft davit falls release < 0.1 seconds after splashdown. The forward davit falls release 1.8 seconds after splashdown. After splashdown the PRoD boom pulls the TEMPSC in a 45° direction before it releases 1.7 seconds later. The TEMPSC then continues to move in a 50° direction away from the FPSO.

Overall the TEMPSC was delivered cleanly to the water with a smooth release of the aft davit release. However, the forward davit did not release until after the PRoD release. The PRoD boom at splashdown was deflected minimally below the PRoD baseline.

Test 913_725_005
2.10m Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 5.2 seconds.

Splashdown Location: Crest

Both davit falls release 0.4 seconds after splashdown. After splashdown the PRoD boom pulls the TEMPSC in a 50° direction before it releases 1.5 seconds later. The TEMPSC then continues to move in a 50° direction away from the FPSO.

Overall the TEMPSC was delivered cleanly to the water with a smooth release of both davits systems. The PRoD boom at splashdown was deflected minimally below the PRoD baseline. No setback was observed.

Test 913_725_006

2.10m Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 5.2 seconds.

Splashdown Location: Crest

Both davit falls release < 0.1 seconds after splashdown. After splashdown the PRoD boom pulls the TEMPSC in a 50° direction before it releases 1.4 seconds later. The TEMPSC then continues to move in a 50° direction away from the FPSO.

Overall the TEMPSC was delivered cleanly to the water with a smooth release of both davits systems. The PRoD boom at splashdown was deflected minimally below the PRoD baseline. No setback was observed.

Test 913_725_007

2.10m Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 5.7 seconds.

Splashdown Location: Trough

Both davit falls release < 0.1 seconds after splashdown. After splashdown the PRoD boom pulls the TEMPSC in a 45° direction before it releases 2.0 seconds later. The TEMPSC then continues to move in a 45° direction away from the FPSO.

Overall the TEMPSC was delivered cleanly to the water with a smooth release of both davits systems. The PRoD boom at splashdown was deflected minimally below the PRoD baseline. No setback was observed. Although the splashdown point was a trough, the TEMPSC did skim the crest of the preceding wave turning the hydrodynamic release light on momentarily.

Test 913_725_008

2.10m Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 5.8 seconds.

Splashdown Location: Up Slope

The aft davit falls release < 0.5 seconds after splashdown. The forward davit falls release 1.8 seconds after splashdown. After splashdown the PRoD boom pulls the TEMPSC in a 55° direction before it releases 1.8 seconds later. The TEMPSC then continues to move in a 55° direction away from the FPSO.

Overall the TEMPSC was delivered cleanly to the water with a smooth release of the aft davit line. The forward davit line did not release until the PRoD boom line released. The PRoD boom at splashdown was deflected minimally below the PRoD baseline. No setback was observed.

Test 913_725_009 *Labeled incorrectly on video*
2.10m Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 5.6 seconds.

Splashdown Location: Up Slope

The aft davit falls release 0.2 seconds after splashdown. The forward davit falls release 1.8 seconds after splashdown. After splashdown the PRoD boom pulls the TEMPSC in a 55° direction before it releases 1.8 seconds later. The TEMPSC then continues to move in a 55° direction away from the FPSO.

Overall the TEMPSC was delivered cleanly to the water with a smooth release of the aft davit line. The forward davit line did not release until the PRoD boom line released. The PRoD boom at splashdown was deflected minimally below the PRoD baseline. No setback was observed.

Test 913_725_010
2.10m Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 5.5 seconds.

Splashdown Location: Crest

Both davit falls release 0.3 seconds after splashdown. After splashdown the PRoD boom pulls the TEMPSC in a 50° direction before it releases 1.8 seconds later. The TEMPSC then continues to move in a 50° direction away from the FPSO.

Overall the TEMPSC was delivered cleanly to the water with a smooth release of the aft davit line. The PRoD boom at splashdown was deflected minimally below the PRoD baseline. No setback was observed.

Test 913_725_011
2.10m Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 5.9 seconds.

Splashdown Location: Trough

Both davit falls release 1.9 seconds after splashdown. After splashdown the PRoD boom pulls the TEMPSC in a 50° direction before it releases 1.9 seconds later. The TEMPSC then continues to move in a 50° direction away from the FPSO.

Overall the TEMPSC was delivered cleanly to the water with a smooth release of the aft davit lines. The PRoD boom at splashdown was deflected minimally below the PRoD baseline. No setback was observed. It should be noted that the davit falls released at the same time as the PRoD lines.

Test 913_725_012
2.10m Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 5.8 seconds.

Splashdown Location: Up Slope

Both davit falls release 1.8 seconds after splashdown. After splashdown the PRoD boom pulls the TEMPSC in a 45° direction before it releases 1.8 seconds later. The TEMPSC then continues to move in a 45° direction away from the FPSO.

Overall the TEMPSC was delivered cleanly to the water with a delayed release of the aft davit lines. The PRoD boom at splashdown was deflected minimally below the PRoD baseline. No setback was observed. It should be noted that the davit falls released at the same time as the PRoD lines.

Test 913_725_013
2.10m Wave Condition

The elapsed time between the start of deployment and the first TEMPSC splashdown is 5.8 seconds. The elapsed time between the start of deployment and the second splashdown is 5.8 seconds.

First Splashdown Location: Crest

Second Splashdown Location: Trough

Both davit falls release < 0.1 seconds after splashdown. After splashdown the PRoD boom pulls the TEMPSC in a 45° direction before it releases 1.9 seconds later. The TEMPSC then continues to move in a 45° direction away from the FPSO.

Overall the TEMPSC was delivered smoothly to the water with a clean release. The PRoD boom at splashdown was deflected 1 boat height below the PRoD baseline. No setback was observed. As indicated the TEMPSC was delivered to the water where it was lifted up again before being set down a second time. The motions were not dramatic due to the low wave height.

Test 913_725_014
2.10m Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 5.2 seconds.

Splashdown Location: Crest

Both davit falls release 0.4 seconds after splashdown. After splashdown the PRoD boom pulls the TEMPSC in a 45° direction before it releases 1.5 seconds later. The TEMPSC then continues to move in a 45° direction away from the FPSO.

Overall the TEMPSC was delivered smoothly to the water with a clean release. The PRoD boom at splashdown was deflected minimally below the PRoD baseline. No setback was observed.

Test 913_725_015
2.10m Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 5.2 seconds.

Splashdown Location: Crest

Both davit falls release < 0.1 seconds after splashdown. After splashdown the PRoD boom pulls the TEMPSC in a 45° direction before it releases 1.4 seconds later. The TEMPSC then continues to move in a 45° direction away from the FPSO.

Overall the TEMPSC was delivered smoothly to the water with a clean release. The PRoD boom at splashdown was deflected minimally below the PRoD baseline. No setback was observed.

Test 913_725_016
2.10m Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 5.4 seconds.

Splashdown Location: Crest

Both davit falls release 1.8 seconds after splashdown. After splashdown the PRoD boom pulls the TEMPSC in a 50° direction before it releases 1.8 seconds later. The TEMPSC then continues to move in a 50° direction away from the FPSO.

Overall the TEMPSC was delivered smoothly to the water with a clean release. The PRoD boom at splashdown was deflected minimally below the PRoD baseline. No setback was observed.

Test 913_725_017
2.10m Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 5.1 seconds.

Splashdown Location: Crest

Both davit falls release 0.4 seconds after splashdown. After splashdown the PRoD boom pulls the TEMPSC in a 55° direction before it releases 1.8 seconds later. The TEMPSC then continues to move in a 55° direction away from the FPSO.

Overall the TEMPSC was delivered smoothly to the water with a clean release. The PRoD boom at splashdown was deflected minimally below the PRoD baseline. No setback was observed.

Test 913_725_018
2.10m Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 5.4 seconds.

Splashdown Location: Crest

Both davit falls release 0.1 seconds after splashdown. After splashdown the PRoD boom pulls the TEMPSC in a 55° direction before it releases 1.8 seconds later. The TEMPSC then continues to move in a 55° direction away from the FPSO.

Overall the TEMPSC was delivered smoothly to the water with a clean release. The PRoD boom at splashdown was deflected minimally below the PRoD baseline. No setback was observed.

Test 913_725_019
2.10m Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 5.7 seconds.

Splashdown Location: Up Slope

The aft davit falls release < 0.1 seconds after splashdown. The forward davit falls release at 1.7 seconds after splashdown. After splashdown the PRoD boom pulls the TEMPSC in a 50° direction before it releases 1.7 seconds later. The TEMPSC then continues to move in a 50° direction away from the FPSO.

Overall the TEMPSC was delivered smoothly to the water with a clean release on the aft davit. The forward davit did not release until the PRoD boom tagline released. The PRoD boom at splashdown was deflected minimally below the PRoD baseline. No setback was observed.

Test 913_725_020
2.10m Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 5.3 seconds.

Splashdown Location: Crest

The forward davit falls release 0.7 seconds after splashdown. The aft davit falls release 1.8 seconds after splashdown. After splashdown the PRoD boom pulls the TEMPSC in a 45° direction before it releases 1.6 seconds later. The TEMPSC then continues to move in a 45° direction away from the FPSO.

Overall the TEMPSC was delivered cleanly to the water with a delayed release on both the aft and forward davit lines. In fact the aft davit line did not release until the PRoD tagline had released. The PRoD boom at splashdown was deflected minimally below the PRoD baseline. No setback was observed.

Test 913_725_021
2.10m Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 5.2 seconds.

Splashdown Location: Down Slope

Both davit falls release at splashdown. After splashdown the PRoD boom pulls the TEMPSC in a 50° direction before it releases 1.2 seconds later. The TEMPSC then continues to move in a 50° direction away from the FPSO.

Overall the TEMPSC was delivered smoothly to the water with a clean release. The PRoD boom at splashdown was deflected minimally below the PRoD baseline. No setback was observed.

Test 913_725_022
2.10m Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 5.2 seconds.

Splashdown Location: Crest

Both davit falls release 0.4 seconds after splashdown. After splashdown the PRoD boom pulls the TEMPSC in a 50° direction before it releases 1.5 seconds later. The TEMPSC then continues to move in a 50° direction away from the FPSO.

Overall the TEMPSC was delivered smoothly to the water with a clean release. The PRoD boom at splashdown was deflected minimally below the PRoD baseline. No setback was observed.

800 Series – TEMPSC Deployment

FPSO Ballast Load, Intact, Heading 20°, Enhanced Deployment, 11.28m Wave Condition

Test 913_800_001
11.28m Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 4.8 seconds.

Splashdown Location: Up Slope

Both davit falls release 0.1 seconds after splashdown. After splashdown the PRoD boom pulls the TEMPSC in an 80° direction before it releases 2.1 seconds later. The TEMPSC then turns, moving in a 50° direction away from the FPSO.

Overall the TEMPSC was delivered cleanly to the water with a smooth release of both the davit falls and the ProD. The PRoD boom at splashdown was deflected 1 boat height below the PRoD baseline. The boom appeared to be very effective in pulling the TEMPSC away from the FPSO.

Test 913_800_002
2.10m Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 4.7 seconds.

Splashdown Location: Up Slope

Both davit falls release 0.7 seconds after splashdown. After splashdown the PRoD boom pulls the TEMPSC in an 80° direction before it releases 2.2 seconds later. The TEMPSC then turns, moving in a 55° direction away from the FPSO.

Overall the TEMPSC was delivered cleanly to the water with a smooth release of both the davit falls and the ProD. The PRoD boom at splashdown was deflected 1.5 boat heights below the PRoD baseline.

Test 913_800_003
11.28m Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 4.7 seconds.

Splashdown Location: Up Slope

Both davit falls release 0.4 seconds after splashdown. After splashdown the PRoD boom pulls the TEMPSC in an 70° direction before it releases 1.9 seconds later. The TEMPSC then continues to move in a 70° direction away from the FPSO.

Overall the TEMPSC was delivered cleanly to the water with a smooth release of both the davit falls and the ProD. The PRoD boom at splashdown was deflected 1.0 boat heights below the PRoD baseline.

Test 913_800_004
11.28m Wave Condition

No data – spoiled file name?

Test 913_800_005
11.28m Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 5.7 seconds.

Splashdown Location: Trough

Both davit falls release 0.4 seconds after splashdown. After splashdown the PRoD boom pulls the TEMPSC in an 80° direction before it releases 2.1 seconds later. The TEMPSC then continues to move in a 80° direction away from the FPSO.

Overall the TEMPSC was delivered cleanly to the water with a smooth release of both the davit falls and the ProD. The PRoD boom at splashdown was deflected 1.5 boat heights below the PRoD baseline.

Test 913_800_006
11.28m Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 4.9 seconds.

Splashdown Location: Up Slope

Both davit falls release 1.4 seconds after splashdown. After splashdown the PRoD boom pulls the TEMPSC in an 80° direction before it releases 2.0 seconds later. The TEMPSC then continues to move in an 80° direction away from the FPSO.

Overall the TEMPSC was delivered cleanly to the water with a smooth release of both the davit falls and the ProD. The PRoD boom at splashdown was deflected 1.0 boat heights below the PRoD baseline. The TEMPSC experienced a 1-boat length setback.

Test 913_800_007

11.28m Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 4.8 seconds.

Splashdown Location: Up Slope

Both davit falls release 0.3 seconds after splashdown. After splashdown the TEMPSC experiences a 1-boat length setback before PRoD boom pulls the TEMPSC in an 80° direction and then releases 2.2 seconds later. The TEMPSC then continues to move in an 80° direction away from the FPSO.

Overall the TEMPSC was delivered cleanly to the water with a smooth release of both the davit falls and the ProD. The PRoD boom at splashdown was deflected 0.5 boat heights below the PRoD baseline. The TEMPSC experienced a 1-boat length setback.

Test 913_800_008

11.28m Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 6.1 seconds.

Splashdown Location: Trough

The aft davit falls release 0.1 seconds after splashdown. The forward davit falls release 2.1 seconds after splashdown. After splashdown the PRoD boom pulls the TEMPSC in an 80° direction and then releases 2.4 seconds later. The TEMPSC then continues to move in an 80° direction away from the FPSO.

Overall the TEMPSC was delivered cleanly to the water with a smooth release of the aft davit and a delayed release of the forward davit line. The PRoD boom at splashdown was deflected 1.0 boat heights below the PRoD baseline. The TEMPSC experienced no setback.

Test 913_800_009

11.28m Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 5.5 seconds.

Splashdown Location: Trough

The aft davit falls release 0.1 seconds after splashdown. The forward davit falls release 1.0 seconds after splashdown. After splashdown the PRoD boom pulls the TEMPSC in an 80° direction and then releases 1.8 seconds later. The TEMPSC then continues to move in an 80° direction away from the FPSO.

Overall the TEMPSC was delivered cleanly to the water with a smooth release of the aft davit and a delayed release of the forward davit line. The PRoD boom at splashdown was deflected 1.0 boat heights below the PRoD baseline. The TEMPSC experienced no setback.

Test 913_800_010
11.28m Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 5.1 seconds.

Splashdown Location: Trough

Both davit falls release 0.1 seconds after splashdown. After splashdown the PRoD boom pulls the TEMPSC in an 80° direction and then releases 2.3 seconds later. The TEMPSC then continues to move in an 80° direction away from the FPSO.

Overall the TEMPSC was delivered cleanly to the water with a smooth release of both davit taglines. The PRoD boom at splashdown was deflected 0.5 boat heights below the PRoD baseline. The TEMPSC experienced a 1/2 boat length setback.

Test 913_800_011
11.28m Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 6.0 seconds.

Splashdown Location: Trough

Both davit falls release < 0.1 seconds after splashdown. After splashdown the PRoD boom pulls the TEMPSC in an 80° direction and then releases 2.3 seconds later. The TEMPSC then continues to move in an 80° direction away from the FPSO.

Overall the TEMPSC was delivered cleanly to the water with a smooth release of both davit taglines. The PRoD boom at splashdown was deflected 1/2 boat heights below the PRoD baseline. The TEMPSC experienced no setback.

Test 913_800_012
11.28m Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 5.4 seconds.

Splashdown Location: Up Slope

Both davit falls release 0.1 seconds after splashdown. After splashdown the PRoD boom pulls the TEMPSC in an 80° direction and then releases 2.2 seconds later. The TEMPSC then continues to move in an 80° direction away from the FPSO.

Overall the TEMPSC was delivered cleanly to the water with a smooth release of both davit taglines. The PRoD boom at splashdown was deflected 1.0 boat heights below the PRoD baseline. The TEMPSC experienced a ½ boat length setback.

Test 913_800_013
11.28m Wave Condition

The elapsed time between the start of deployment and the first TEMPSC splashdown is 4.5 seconds. The elapsed time between the start of deployment and the second TEMPSC splashdown is 6.4 seconds.

First Splashdown Location: Up Slope

Second Splashdown Location: Trough

The aft davit falls release 0.1 seconds after splashdown. The forward davit falls release 2.2 seconds after splashdown. After splashdown the PRoD boom pulls the TEMPSC in a 90° direction and then releases 2.5 seconds later. The TEMPSC then continues to move in an 90° direction away from the FPSO.

Overall the TEMPSC was delivered cleanly to the water with a smooth release of the aft davit tagline and a delayed release of the forward davit falls. The PRoD boom at splashdown was deflected 2.0 boat heights below the PRoD baseline. The TEMPSC experienced a small amount of setback in the lateral direction due to it being beam on to the wave.

Test 913_800_014
11.28m Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 5.7 seconds.

Splashdown Location: Trough

Both davit falls release 0.2 seconds after splashdown. After splashdown the PRoD boom pulls the TEMPSC in an 80° direction and then releases 2.3 seconds later. The TEMPSC then continues to move in an 80° direction away from the FPSO.

Overall the TEMPSC was delivered cleanly to the water with a smooth release of both davit taglines. The PRoD boom at splashdown was deflected 1.0 boat heights below the PRoD baseline. The TEMPSC experienced no setback.

Test 913_800_015
11.28m Wave Condition

The elapsed time between the start of deployment and the first TEMPSC splashdown is 4.5 seconds. The elapsed time between the start of deployment and the second TEMPSC splashdown is 6.6 seconds.

First Splashdown Location: Up Slope

Second Splashdown Location: Trough

The aft davit falls release 0.1 seconds after splashdown. The forward davit falls release 1.8 seconds after splashdown. After splashdown the PRoD boom pulls the TEMPSC in a 80° direction and then releases 2.3 seconds later. The TEMPSC then continues to move in a 80° direction away from the FPSO.

Overall the TEMPSC was delivered cleanly to the water with a smooth release of the aft davit tagline and a delayed release of the forward davit falls. The PRoD boom at splashdown was deflected 2.0 boat heights below the PRoD baseline. The TEMPSC experienced a small amount of setback in the lateral direcion due to it being beam on to the wave.

Test 913_800_016
11.28m Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 4.7 seconds.

Splashdown Location: Up Slope

Both davit falls release 0.1 seconds after splashdown. After splashdown the PRoD boom pulls the TEMPSC in a 70° direction and then releases 1.5 seconds later. The TEMPSC then continues to move in a 70° direction away from the FPSO.

Overall the TEMPSC was delivered cleanly to the water with a smooth release of both davit taglines. The PRoD boom at splashdown was deflected 0.5 boat heights below the PRoD baseline. The TEMPSC experienced no setback.

Test 913_800_017
11.28m Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 4.7 seconds.

Splashdown Location: Up Slope

Both davit falls release 0.1 seconds after splashdown. After splashdown the PRoD boom pulls the TEMPSC in a 55° direction and then releases 1.7 seconds later. The TEMPSC then continues to move in a 55° direction away from the FPSO.

Overall the TEMPSC was delivered cleanly to the water with a smooth release of both davit taglines. The PRoD boom at splashdown was deflected minimally below the PRoD baseline. The TEMPSC experienced a 1/2 boat length setback.

Test 913_800_018

11.28m Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 4.7 seconds.

Splashdown Location: Up Slope

Both davit falls release 0.4 seconds after splashdown. After splashdown the PRoD boom pulls the TEMPSC in a 70° direction and then releases 2.2 seconds later. The TEMPSC then continues to move in a 70° direction away from the FPSO.

Overall the TEMPSC was delivered cleanly to the water with a smooth release of both davit taglines. The PRoD boom at splashdown was deflected minimally below the PRoD baseline. The TEMPSC experienced a 1-boat length setback.

Test 913_800_019

11.28m Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 5.0 seconds.

Splashdown Location: Trough

Both davit falls release 0.4 seconds after splashdown. After splashdown the PRoD boom pulls the TEMPSC in a 70° direction and then releases 2.3 seconds later. The TEMPSC then continues to move in a 70° direction away from the FPSO.

Overall the TEMPSC was delivered cleanly to the water with a smooth release of both davit taglines. The PRoD boom at splashdown was deflected minimally below the PRoD baseline. The TEMPSC experienced a 1-boat length setback.

Test 913_800_020

11.28m Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 5.1 seconds.

Splashdown Location: Trough

Both davit falls release 0.1 seconds after splashdown. After splashdown the PRoD boom pulls the TEMPSC in a 60° direction and then releases 2.4 seconds later. The TEMPSC then continues to move in a 60° direction away from the FPSO.

Overall the TEMPSC was delivered cleanly to the water with a smooth release of both davit taglines. The PRoD boom at splashdown was deflected 0.5 boat heights below the PRoD baseline. The TEMPSC experienced a 1/2 boat length setback.

Test 913_800_021
11.28m Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 4.7 seconds.

Splashdown Location: Trough

Both davit falls release < 0.1 seconds after splashdown. After splashdown the PRoD boom pulls the TEMPSC in a 70° direction and then releases 1.9 seconds later. The TEMPSC then continues to move in a 70° direction away from the FPSO.

Overall the TEMPSC was delivered cleanly to the water with a smooth release of both davit taglines. The PRoD boom at splashdown was deflected minimally below the PRoD baseline. The TEMPSC experienced a 1-boat length setback.

900 Series – TEMPSC Enhanced Deployment

FPSO Ballast Load, Intact, Heading 20°, Irregular Wave Condition, Enhanced Deployment

Test 913_900_001
10.90m Irregular Wave Condition

No video.

Test 913_900_002
3.50m Irregular Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 5.3 seconds.

Splashdown Location: Down Slope

Both davit falls release 0.1 seconds before splashdown. This early release causes the TEMPSC to drop to the water (10 mm). The PRoD release occurs 1.6 seconds after splashdown. The TEMPSC moves in a 20° heading away from the FPSO without many problems.

Overall the TEMPSC was deployed smoothly to the water with an early release. The early release did not drastically affect the TEMPSC and may not be visible in the data. The PRoD boom pulled the TEMPSC away from the FPSO in a 20° heading with a clean release. No setback was observed. **There did not seem to be any wind for this run**.

Test 913_900_003
7.0m Irregular Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 4.7 seconds.

Splashdown Location: Up Slope

Both davit falls release 0.4 seconds after splashdown. The PRoD release occurs 1.7 seconds after splashdown. The TEMPSC moves in a 40° heading away from the FPSO without many problems.

Overall the TEMPSC was deployed smoothly to the water with an early release. The PRoD boom pulled the TEMPSC away from the FPSO in a 40° heading with a clean release. No setback was observed.

Test 913_900_004
10.90m Irregular Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 5.2 seconds.

Splashdown Location: Crest

Both davit falls release 0.2 seconds after splashdown. The PRoD release occurs 1.0 seconds after splashdown. The TEMPSC moves in a 45° heading away from the FPSO without many problems.

Overall the TEMPSC was deployed smoothly to the water with a clean release. The PRoD boom pulled the TEMPSC away from the FPSO in a 40° heading with a clean release. No setback was observed.

Test 913_900_005

10.90m Irregular Wave Condition

Doesn't appear to be a run 5. Not on video, not on log.

Test 913_900_006

11.28m Regular Wave Condition

The elapsed time between the start of deployment and TEMPSC splashdown is 4.5 seconds.

Splashdown Location: Up Slope

Both davit falls release 0.5 seconds after splashdown. After splashdown the PRoD boom pulls the TEMPSC in an 80° direction before it releases 1.9 seconds later. The TEMPSC then turns, moving in a 45° direction away from the FPSO.

Overall the TEMPSC was deployed smoothly to the water with a clean release. The PRoD boom pulled the TEMPSC away from the FPSO in an 80° heading with a clean release. This near perpendicuar direction appears to be a function of the amount of setback. The larger the setback, the more the ProD boom pulls the TEMPSC bow perpendicular to the FPSO. In this run there was a 1-boat length setback.

Test 913_900_007

10.90m Irregular Wave Condition

The elapsed time between the start of deployment and the first TEMPSC splashdown is 4.7 seconds. The elapsed time between the start of deployment and the second TEMPSC splashdown is 6.6 seconds.

First Splashdown Location: Up Slope

Second Splashdown Location: Up Slope

It is impossible to discern at what time the davit falls were released due to the severe setback. The PRoD pole was pulled down and back until it was 2 boat heights below the base and 2 boat lengths back. The PRoD however did recover, pulling the TEMPSC forward on a 60° angle with the release occuring 3.1 seconds after final splashdown.

Overall the TEMPSC was not delivered smoothly to the water. The TEMPSC slammed into an approaching wave. After reaching the crest of the wave the FPSO upward heave motion pulled the TEMPSC back up into the air. On the downward heave motion the TEMPSC again slammed into an approaching wave. The slack in the line added with the extreme downward pitch of the FPSO, causing the TEMPSC to be pulled back and resulting in a setback of over 3 boat lengths. The PRoD boom did prevent the TEMPSC from hitting the hull, however it did appear to be under extreme stress.

Appendix 10 Video Log

Evacuation System PJ913 Research Program

Date	Time	Test	Drive signal	Comments	Video #	Time	Additional Comments
Lifeboat removed, FPSO at 20 deg heading, Ballast cond. Enviro repeats							
1-Feb-2000	09.33:26	Test913_300_001	REG_H1P01_T5P6_DRV	Wind @1.37 volts	3	0.00:00	
1-Feb-2000	09:44:42	Test913_301_001	REG_H2P10_T7P7_DRV	Wind @1.86 volts	3	0:01:53	
1-Feb-2000	11:12:48	Test913_302_001	REG_H3P98_T9P9_DRV	Wind @2.40 volts	3	0:04:29	
1-Feb-2000	11:26:46	Test913_303_001	REG_H6P71_T12P1_DRV	Wind @2.93 volts	3	0:08:42	
1-Feb-2000	11:42:37	Test913_304_001	REG_H11P28_T14P9_DRV	Wind @3.62 volts	3	0:09:17	
Lifeboat Launch FPSO at 20 deg heading, Ballast cond. Calm water							
1-Feb-2000	14:45:34	Test913_400_001	Calm Run	N/A	3	0:12:00	
1-Feb-2000	14:50.20	Test913_400_002	Calm Run	N/A	3	0:13:48	
1-Feb-2000	14:54:20	Test913_400_003	Calm Run	N/A	3	0:14:39	
1-Feb-2000	14:57:04	Test913_400_004	Calm Run	N/A	3	0:15:21	
1-Feb-2000	14:59:34	Test913_400_005	Calm Run	(bad release)	3	0:16:06	
1-Feb-2000	15:02:21	Test913_400_006	Calm Run	N/A	3	0:16:45	
1-Feb-2000	15.05:18	Test913_400_007	Calm Run	N/A	3	0:17:26	
1-Feb-2000	15:08:22	Test913_400_008	Calm Run	N/A	3	0:18:09	
1-Feb-2000	15:11:04	Test913_400_009	Calm Run	N/A	3	0:18:42	
1-Feb-2000	15:13:21	Test913_400_010	Calm Run	N/A	3	0:19.18	
1-Feb-2000	15:16:21	Test913_400_011	Calm Run	N/A	3	0:20:00	
1-Feb-2000	15:19:17	Test913_400_012	Calm Run	N/A	3	0:20:43	
1-Feb-2000	15.22:39	Test913_400_013	Calm Run	N/A	3	0:21:24	
1-Feb-2000	15:26:31	Test913_400_014	Calm Run	N/A	3	0:22:03	
1-Feb-2000	15.29.04	Test913_400_015	Calm Run	N/A	3	0:22:36	
1-Feb-2000	15:32:13	Test913_400_016	Calm Run	N/A	3	0:23:17	
1-Feb-2000	15:35.09	Test913_400_017	Calm Run	N/A	3	0:23:52	
1-Feb-2000	15:37:23	Test913_400_018	Calm Run	N/A	3	0:24:32	
1-Feb-2000	15:39:52	Test913_400_019	Calm Run	N/A	3	0:25:19	
1-Feb-2000		Test913_400_020	Calm Run	N/A	3	0:26:08	
1-Feb-2000	15:45:43	Test913_400_021	Calm Run	N/A	3	0:26:47	

Evacuation System PJ913 Research Program

Lifeboat Launch FPSO at 20 deg heading, Ballast cond. 1.01 m wave cond.							
2-Feb-2000	N/A	N/A	Video grid reference	N/A	3	0:27:25	
2-Feb-2000	14:59:56	Test913_500_001	REG_H1P01_T5P6_DRV	Wind @1.37 volts	3	0:28:44	
2-Feb-2000	15:14:07	Test913_500_002	REG_H1P01_T5P6_DRV	Wind @1.37 volts	3	0:30:13	
2-Feb-2000	15:24:03	Test913_500_003	REG_H1P01_T5P6_DRV	Wind @1.37 volts	3	0:32:06	
2-Feb-2000	15:34:05	Test913_500_004	REG_H1P01_T5P6_DRV	Wind @1.37 volts	3	0:33:58	
2-Feb-2000	15:44:02	Test913_500_005	REG_H1P01_T5P6_DRV	Wind @1.37 volts	3	0:35:55	
2-Feb-2000	15:54:02	Test913_500_006	REG_H1P01_T5P6_DRV	Wind @1.37 volts	3	0:37:31	
2-Feb-2000	16:08:49	Test913_500_007	REG_H1P01_T5P6_DRV	Wind @1.37 volts	3	0:39:13	
2-Feb-2000	16:17:55	Test913_500_008	REG_H1P01_T5P6_DRV	Wind @1.37 volts	3	0:40:40	
2-Feb-2000	16:28:11	Test913_500_009	REG_H1P01_T5P6_DRV	Wind @1.37 volts	3	0:42:17	
2-Feb-2000	16:38:22	Test913_500_010	REG_H1P01_T5P6_DRV	Wind @1.37 volts	3	0:44:08	
2-Feb-2000	16:48:46	Test913_500_011	REG_H1P01_T5P6_DRV	Wind @1.37 volts	3	0:46:41	
3-Feb-2000	9:20:53	Test913_500_012	REG_H1P01_T5P6_DRV	Wind @1.37 volts	3	0:46:59	
3-Feb-2000	9:30:10	Test913_500_013	REG_H1P01_T5P6_DRV	Wind @1.37 volts	3	0:48:28	
3-Feb-2000	9:39:34	Test913_500_014	REG_H1P01_T5P6_DRV	Wind @1.37 volts	3	0:50:39	
3-Feb-2000	9:50:00	Test913_500_015	REG_H1P01_T5P6_DRV	Wind @1.37 volts	3	0:53:03	
3-Feb-2000	10:00:02	Test913_500_016	REG_H1P01_T5P6_DRV	Wind @1.37 volts	3	0:54:54	
3-Feb-2000	10:19:48	Test913_500_017	REG_H1P01_T5P6_DRV	Wind @1.37 volts	3	0:56:22	
3-Feb-2000	10:29:06	Test913_500_018	REG_H1P01_T5P6_DRV	Wind @1.37 volts	3	0:58:06	
3-Feb-2000	10:39:54	Test913_500_019	REG_H1P01_T5P6_DRV	Wind @1.37 volts	3	0:59:49	No qualisys
3-Feb-2000	10:49:14	Test913_500_020	REG_H1P01_T5P6_DRV	Wind @1.37 volts	3	1:01:35	
3-Feb-2000	10:58:50	Test913_500_021	REG_H1P01_T5P6_DRV	Wind @1.37 volts	3	1:03:17	
Lifeboat Launch FPSO at 20 deg heading, Ballast cond. 2.10 m wave cond.							
3-Feb-2000	14:46:37	Test913_525_001	REG_H2P10_T7P7_DRV	Wind @1.86 volts	3	1:05:16	
3-Feb-2000	14:56:51	Test913_525_002	REG_H2P10_T7P7_DRV	Wind @1.86 volts	3	1:06:29	
3-Feb-2000	15:05:53	Test913_525_003	REG_H2P10_T7P7_DRV	Wind @1.86 volts	3	1:08:08	
3-Feb-2000	15:22:39	Test913_525_004	REG_H2P10_T7P7_DRV	Wind @1.86 volts	3	1:09:32	
Lifeboat Launch & TC Demo, FPSO at 20 deg heading, Ballast cond. 6.71 m wave cond.							
3-Feb-2000	15:32:12	Test913_600_001	REG_H6P71_T12P1_DRV	Wind @2.93 volts	3	1:10:33	
Lifeboat Launch & TC Demo, FPSO at 20 deg heading, Ballast cond. 11.28 m wave cond.							
3-Feb-2000	15:42:10	Test913_625_001	REG_H11P28_T14P9_DRV	Wind @3.62 volts	3	1:12:14	
Lifeboat Launch Demo FPSO at 20 deg heading, Ballast cond. 10.9 m Irr wave cond.							
3-Feb-2000	15:52:15	Test913_900_001	Jon_Hs10p9_tp14p8_drv_M	Wind @ 5.3 volts	3	1:13:36	
Lifeboat Launch FPSO at 20 deg heading, Ballast cond. 2.10 m wave cond.							
3-Feb-2000	16:01:45	Test913_525_005	REG_H2P10_T7P7_DRV	Wind @1.86 volts	3	1:15:17	
3-Feb-2000	16:20:41	Test913_525_006	REG_H2P10_T7P7_DRV	Wind @1.86 volts	3	1:16:26	
3-Feb-2000	16:29:57	Test913_525_007	REG_H2P10_T7P7_DRV	Wind @1.86 volts	3	1:17:43	
3-Feb-2000	16:40:21	Test913_525_008	REG_H2P10_T7P7_DRV	Wind @1.86 volts	3	1:18:49	
3-Feb-2000	16:50:02	Test913_525_009	REG_H2P10_T7P7_DRV	Wind @1.86 volts	3	1:20:07	

Evacuation System PJ913 Research Program

4-Feb-2000	9 15 53	Test913_525_010	REG_H2P10_T7P7_DRV	Wind @1 86 volts	3	1:21:11	
4-Feb-2000	9 24 40	Test913_525_011	REG_H2P10_T7P7_DRV	Wind @1 86 volts	3	1:22:34	Qualisys files failed
4-Feb-2000	9 34 35	Test913_525_012	REG_H2P10_T7P7_DRV	Wind @1 86 volts	3	1:24:11	Qualisys files failed
4-Feb-2000	9 45 38	Test913_525_013	REG_H2P10_T7P7_DRV	Wind @1 86 volts	3	1:25:41	
4-Feb-2000	9 54 49	Test913_525_014	REG_H2P10_T7P7_DRV	Wind @1 86 volts	3	1:27:12	Qualisys fail
4-Feb-2000	10 29 24	Test913_525_015	REG_H2P10_T7P7_DRV	Wind @1 86 volts	3	1:28:25	
4-Feb-2000	10 40 12	Test913_525_016	REG_H2P10_T7P7_DRV	Wind @1 86 volts	3	1:29:33	
4-Feb-2000	10 49 13	Test913_525_017	REG_H2P10_T7P7_DRV	Wind @1 86 volts	3		Deck video only
							Lifeboat control pc crash
4-Feb-2000	14 00 27	Test913_525_018	REG_H2P10_T7P7_DRV	Wind @1 86 volts	3		Video fail, Deck video only
4-Feb-2000	14 13 06	Test913_525_019	REG_H2P10_T7P7_DRV	Wind @1 86 volts	3	1:31:21	
4-Feb-2000	14 23 05	Test913_525_020	REG_H2P10_T7P7_DRV	Wind @1 86 volts	3	1:33:03	
4-Feb-2000	14 33 06	Test913_525_021	REG_H2P10_T7P7_DRV	Wind @1 86 volts	3	1:34:09	
4-Feb-2000	14 45 05	Test913_525_022	REG_H2P10_T7P7_DRV	Wind @1 86 volts	3	1:36:18	
4-Feb-2000	14 54 59	Test913_525_023	REG_H2P10_T7P7_DRV	Wind @1 86 volts	3	1:38:22	
4-Feb-2000	15 06 08	Test913_525_024	REG_H2P10_T7P7_DRV	Wind @1 86 volts	3	1:39:41	
4-Feb-2000	15 16 49	Test913_525_025	REG_H2P10_T7P7_DRV	Wind @1 86 volts	3	1:40:48	
		Lifeboat Launch FPSO at 20 deg heading. Ballast cond. 3.96 m wave cond.					
4-Feb-2000	15 47 09	Test913_550_001	REG_H3P96_T9P9_DRV	Wind @2 40 volts	3	1:42:11	
4-Feb-2000	15 57 41	Test913_550_002	REG_H3P96_T9P9_DRV	Wind @2 40 volts	3	1:43:20	Lifeboat release fail
4-Feb-2000	16 08 59	Test913_550_003	REG_H3P96_T9P9_DRV	Wind @2 40 volts	3	1:45:06	
4-Feb-2000	16 17 15	Test913_550_004	REG_H3P96_T9P9_DRV	Wind @2 40 volts	3	1:46:15	Lifeboat batteries low, speed down
7-Feb-2000	13 54 00	Test913_550_005	REG_H3P96_T9P9_DRV	Wind @2 40 volts	3	1:48:16	Waveboards on low press
7-Feb-2000	14 04 05	Test913_550_006	REG_H3P96_T9P9_DRV	Wind @2 40 volts	3	1:49:29	Waveboards on low press
7-Feb-2000	14 15 06	Test913_550_007	REG_H3P96_T9P9_DRV	Wind @2 40 volts	3	1:50:48	
7-Feb-2000	14 23 56	Test913_550_008	REG_H3P96_T9P9_DRV	Wind @2 40 volts	3	1:52:00	
7-Feb-2000	14 34 05	Test913_550_009	REG_H3P96_T9P9_DRV	Wind @2 40 volts	3	1:53:32	
7-Feb-2000	14 45 27	Test913_550_010	REG_H3P96_T9P9_DRV	Wind @2 40 volts	3	1:55:00	
7-Feb-2000	14 54 07	Test913_550_011	REG_H3P96_T9P9_DRV	Wind @2 40 volts	3	1:56:20	
7-Feb-2000	15 15 27	Test913_550_012	REG_H3P96_T9P9_DRV	Wind @2 40 volts	4	0:00:00	no deck video
7-Feb-2000	15 25 57	Test913_550_013	REG_H3P96_T9P9_DRV	Wind @2 40 volts	4	0:01:03	no deck video
7-Feb-2000	15 34 37	Test913_550_014	REG_H3P96_T9P9_DRV	Wind @2 40 volts	4	0:02:23	
7-Feb-2000	15 47 29	Test913_550_015	REG_H3P96_T9P9_DRV	Wind @2 40 volts	4	0:03:43	
7-Feb-2000	15 57 40	Test913_550_016	REG_H3P96_T9P9_DRV	Wind @2 40 volts	4	0:06:47	
7-Feb-2000	16 08 01	Test913_550_017	REG_H3P96_T9P9_DRV	Wind @2 40 volts	4	0:07:50	Failed lifeboat release
8-Feb-2000	9 26 12	Test913_550_018	REG_H3P96_T9P9_DRV	Wind @2 40 volts	4	0:09:15	
8-Feb-2000	9 35:24	Test913_550_019	REG_H3P96_T9P9_DRV	Wind @2 40 volts	4		
8-Feb-2000	9 45 12	Test913_550_020	REG_H3P96_T9P9_DRV	Wind @2 40 volts	4	0:11:29	
8-Feb-2000	9 55 09	Test913_550_021	REG_H3P96_T9P9_DRV	Wind @2 40 volts	4	0:12:56	
8-Feb-2000	10 18 01	Test913_550_022	REG_H3P96_T9P9_DRV	Wind @2 40 volts	4	0:14:06	
8-Feb-2000	10 28 02	Test913_550_023	REG_H3P96_T9P9_DRV	Wind @2 40 volts	4	0:15:49	
8-Feb-2000	10 38 32	Test913_550_024	REG_H3P96_T9P9_DRV	Wind @2 40 volts	4	0:16:57	
8-Feb-2000	10 48 30	Test913_550_025	REG_H3P96_T9P9_DRV	Wind @2 40 volts	4	0:18:20	

Evacuation System P 913 Research Program

Lifeboat Launch FPSO at 20 deg heading, Ballast cond. 6.71 m wave cond.

8-Feb-2000	10:57:51	Test913_600_002	REG_H6P71_T12P1_DRV	Wind @2.93 volts	4	0:19:46	
8-Feb-2000	11:08:23	Test913_600_003	REG_H6P71_T12P1_DRV	Wind @2.93 volts	4	0:21:02	
8-Feb-2000	11:17:52	Test913_600_004	REG_H6P71_T12P1_DRV	Wind @2.93 volts	4	0:22:18	
8-Feb-2000	11:29:46	Test913_600_005	REG_H6P71_T12P1_DRV	Wind @2.93 volts	4	0:23:44	

Lifeboat Launch Demo FPSO at 20 deg heading, Ballast cond. 10.9 m irr wave cond.

8-Feb-2000	13:50:33	Test913_900_002	JON_HS3P5_TP10P6_DRV_H	Wind @ 2.3volts	4	0:24:57	
8-Feb-2000	13:55:58	Test913_900_003	JON_HS7P5_TP13P0_DRV_H	Wind @ 4.22volts	4	0:26:34	
8-Feb-2000	14:01:20	Test913_900_004	JON_HS10P9_TP14P6_DRV_H	Wind @ 5.3 volts	4	0:28:07	
8-Feb-2000	14:10:23	Test913_625_002	REG_H11P28_T14P9_DRV	Wind @3.62 volts	4	0:30:01	No valid data this run.

Lifeboat Launch FPSO at 20 deg heading, Ballast cond. 6.71 m wave cond.

8-Feb-2000	14:25:39	Test913_600_006	REG_H6P71_T12P1_DRV	Wind @2.93 volts	4	0:31:33	
8-Feb-2000	14:36:30	Test913_600_007	REG_H6P71_T12P1_DRV	Wind @2.93 volts	4	0:32:47	
8-Feb-2000	14:45:07	Test913_600_008	REG_H6P71_T12P1_DRV	Wind @2.93 volts	4	0:34:13	
8-Feb-2000	14:56:06	Test913_600_009	REG_H6P71_T12P1_DRV	Wind @2.93 volts	4	0:35:49	
8-Feb-2000	15:19:37	Test913_600_010	REG_H6P71_T12P1_DRV	Wind @2.93 volts	4	0:37:27	
8-Feb-2000	15:28:46	Test913_600_011	REG_H6P71_T12P1_DRV	Wind @2.93 volts	4	0:38:34	
8-Feb-2000	15:38:57	Test913_600_012	REG_H6P71_T12P1_DRV	Wind @2.93 volts	4	0:39:50	
8-Feb-2000	15:48:52	Test913_600_013	REG_H6P71_T12P1_DRV	Wind @2.93 volts	4	0:41:19	
8-Feb-2000	16:01:01	Test913_600_014	REG_H6P71_T12P1_DRV	Wind @2.93 volts	4	0:42:51	Waveboards running out of phase
8-Feb-2000	16:12:46	Test913_600_015	REG_H6P71_T12P1_DRV	Wind @2.93 volts	4	0:44:32	Lifeboat release failure
9-Feb-2000	9:38:19	Test913_600_016	REG_H6P71_T12P1_DRV	Wind @2.93 volts	4	0:46:16	
9-Feb-2000	9:48:02	Test913_600_017	REG_H6P71_T12P1_DRV	Wind @2.93 volts	4	0:47:53	
9-Feb-2000	9:58:10	Test913_600_018	REG_H6P71_T12P1_DRV	Wind @2.93 volts	4	0:49:36	
9-Feb-2000	10:17:51	Test913_600_019	REG_H6P71_T12P1_DRV	Wind @2.93 volts	4	0:50:48	
9-Feb-2000	10:27:09	Test913_600_020	REG_H6P71_T12P1_DRV	Wind @2.93 volts	4	0:51:53	
9-Feb-2000	10:37:10	Test913_600_021	REG_H6P71_T12P1_DRV	Wind @2.93 volts	4	0:53:09	
9-Feb-2000	10:47:06	Test913_600_022	REG_H6P71_T12P1_DRV	Wind @2.93 volts	4	0:55:19	

Lifeboat Launch FPSO at 20 deg heading, Ballast cond. 11.28 m wave cond.

9-Feb-2000	10:58:06	Test913_625_003	REG_H11P28_T14P9_DRV	Wind @3.62 volts	4	0:56:56	Video incorrectly labeled _002, Lifeboat release fail.
9-Feb-2000	11:18:35	Test913_625_004	REG_H11P28_T14P9_DRV	Wind @3.62 volts	4	0:58:17	
9-Feb-2000	11:27:04	Test913_625_005	REG_H11P28_T14P9_DRV	Wind @3.62 volts	4	0:59:19	
9-Feb-2000	11:39:44	Test913_625_006	REG_H11P28_T14P9_DRV	Wind @3.62 volts	4	1:00:42	
9-Feb-2000	11:48:58	Test913_625_007	REG_H11P28_T14P9_DRV	Wind @3.62 volts	4	1:01:49	Lifeboat release fail
9-Feb-2000	13:39:30	Test913_625_008	REG_H11P28_T14P9_DRV	Wind @3.62 volts	4	1:03:16	
9-Feb-2000	13:49:23	Test913_625_009	REG_H11P28_T14P9_DRV	Wind @3.62 volts	4	1:04:59	
9-Feb-2000	13:59:38	Test913_625_010	REG_H11P28_T14P9_DRV	Wind @3.62 volts	4	1:06:18	
9-Feb-2000	14:09:07	Test913_625_011	REG_H11P28_T14P9_DRV	Wind @3.62 volts	4	1:07:30	
9-Feb-2000	14:19:23	Test913_625_012	REG_H11P28_T14P9_DRV	Wind @3.62 volts	4	1:08:53	
9-Feb-2000	14:28:50	Test913_625_013	REG_H11P28_T14P9_DRV	Wind @3.62 volts	4	1:10:13	
9-Feb-2000	14:39:07	Test913_625_014	REG_H11P28_T14P9_DRV	Wind @3.62 volts	4	1:11:42	
9-Feb-2000	14:48:56	Test913_625_015	REG_H11P28_T14P9_DRV	Wind @3.62 volts	4	1:12:51	

Evacuation System PJ913 Research Program

9-Feb-2000	14:59:24	Test913_625_016	REG_H11P28_T14P9_DRV	Wind @3.62 volts	4	1:14:52	Lifeboat release fail
9-Feb-2000	15:47:45	Test913_625_017	REG_H11P28_T14P9_DRV	Wind @3.62 volts	4	1:15:57	
9-Feb-2000	15:57:01	Test913_625_018	REG_H11P28_T14P9_DRV	Wind @3.62 volts	4	1:17:13	
9-Feb-2000	16:06:39	Test913_625_019	REG_H11P28_T14P9_DRV	Wind @3.62 volts	4	1:18:37	Deck video changed to tape 4a
9-Feb-2000	16:16:43	Test913_625_020	REG_H11P28_T14P9_DRV	Wind @3.62 volts	4	1:19:56	
9-Feb-2000	16:27:51	Test913_625_021	REG_H11P28_T14P9_DRV	Wind @3.62 volts	4	1:21:10	
9-Feb-2000	16:36:57	Test913_625_022	REG_H11P28_T14P9_DRV	Wind @3.62 volts	4	1:22:18	
9-Feb-2000	16:46:54	Test913_625_023	REG_H11P28_T14P9_DRV	Wind @3.62 volts	4	1:23:19	
9-Feb-2000	16:57:18	Test913_625_024	REG_H11P28_T14P9_DRV	Wind @3.62 volts	4	1:24:44	
Lifeboat Launch FPSO at 20 deg heading,enhanced deployment, Ballast cond. 2.10 m wave cond.							
10-Feb-2000	9:54:24	Test913_725_001	REG_H2P10_T7P7_DRV	Wind @1.86 volts	4	1:25:32	Lifeboat propulsion in-op
10-Feb-2000	10:39:35	Test913_725_002	REG_H2P10_T7P7_DRV	Wind @1.86 volts	4	1:28:21	
10-Feb-2000	10:48:44	Test913_725_003	REG_H2P10_T7P7_DRV	Wind @1.86 volts	4	1:29.17	
Lifeboat Launch Demo FPSO at 20 deg heading, Ballast cond. Enhanced deployment							
10-Feb-2000	10:59:07	Test913_900_006	REG_H11P28_T14P9_DRV	Wind @3.62 volts	4	1:30:21	
10-Feb-2000	11:04:48	Test913_900_007	JON_HS10P9_TP14P8_DRV_M	Wind @ 5.3 volts	4	1:31:51	
Lifeboat Launch FPSO at 20 deg heading,enhanced deployment, Ballast cond. 2.10 m wave cond.							
10-Feb-2000	11:21:10	Test913_725_004	REG_H2P10_T7P7_DRV	Wind @1.86 volts	4	1:33:35	
10-Feb-2000	11:31:06	Test913_725_005	REG_H2P10_T7P7_DRV	Wind @1.86 volts	4	1:34:38	Daqbook crash
10-Feb-2000	11:43:36	Test913_725_006	REG_H2P10_T7P7_DRV	Wind @1.86 volts	4	1:35:46	
10-Feb-2000	11:53:13	Test913_725_007	REG_H2P10_T7P7_DRV	Wind @1.86 volts	4	1:37:12	
10-Feb-2000	13:36:04	Test913_725_008	REG_H2P10_T7P7_DRV	Wind @1.86 volts	4	1:38:09	
10-Feb-2000	13:46:31	Test913_725_009	REG_H2P10_T7P7_DRV	Wind @1.86 volts	4	1:39:05	
10-Feb-2000	13:56:20	Test913_725_010	REG_H2P10_T7P7_DRV	Wind @1.86 volts	4	1:40:01	
10-Feb-2000	14:06:07	Test913_725_011	REG_H2P10_T7P7_DRV	Wind @1.86 volts	4	1:40:59	
Lifeboat Launch FPSO at 20 deg heading,enhanced deployment, Ballast cond. 11.28 m wave cond.							
10-Feb-2000	14:18:37	Test913_800_001	REG_H11P28_T14P9_DRV	Wind @3.62 volts	4	1:42:02	
Lifeboat Launch FPSO at 20 deg heading,enhanced deployment, Ballast cond. 2.10 m wave cond.							
10-Feb-2000	14:29:41	Test913_725_012	REG_H2P10_T7P7_DRV	Wind @1.86 volts	4	1:43:36	
Lifeboat Launch FPSO at 20 deg heading,enhanced deployment, Ballast cond. 11.28 m wave cond.							
10-Feb-2000	14:42:53	Test913_800_002	REG_H11P28_T14P9_DRV	Wind @3.62 volts	4	1:44:37	
10-Feb-2000	14:51:33	Test913_800_003	REG_H11P28_T14P9_DRV	Wind @3.62 volts	4	1:45:50	
Lifeboat Launch FPSO at 20 deg heading,enhanced deployment, Ballast cond. 2.10 m wave cond.							
10-Feb-2000	15:36:06	Test913_725_013	REG_H2P10_T7P7_DRV	Wind @1.86 volts	4	1:47:29	
10-Feb-2000	15:45:51	Test913_725_014	REG_H2P10_T7P7_DRV	Wind @1.86 volts	4	1:48:22	
10-Feb-2000	15:55:32	Test913_725_015	REG_H2P10_T7P7_DRV	Wind @1.86 volts	4	1:49:22	
10-Feb-2000	16:05:29	Test913_725_016	REG_H2P10_T7P7_DRV	Wind @1.86 volts	4	1:50:32	
10-Feb-2000	16:15:01	Test913_725_017	REG_H2P10_T7P7_DRV	Wind @1.86 volts	4	1:51:33	
10-Feb-2000	16:25:38	Test913_725_018	REG_H2P10_T7P7_DRV	Wind @1.86 volts	4	1:52:31	
10-Feb-2000	16:35:37	Test913_725_019	REG_H2P10_T7P7_DRV	Wind @1.86 volts	4	1:53:33	
10-Feb-2000	16:45.55	Test913_725_020	REG_H2P10_T7P7_DRV	Wind @1.86 volts	4	1:54:30	
12-Feb-2000	9:11:07	Test913_725_021	REG_H2P10_T7P7_DRV	Wind @1.86 volts	4	1:55:30	
12-Feb-2000	9:23:20	Test913_725_022	REG_H2P10_T7P7_DRV	Wind @1.86 volts	4	1:56:32	

Evacuation System PJ9_3 Research Program

Lifeboat Launch FPSO at 20 deg heading,enhanced deployment, Ballast cond. 11.28 m wave cond.

12-Feb-2000	n/a	Test913_800_004	REG_H11P28_T14P9_DRV	Wind @3.62 volts	n/a	n/a	spoiled filename
12-Feb-2000	9:38:06	Test913_800_005	REG_H11P28_T14P9_DRV	Wind @3.62 volts	5	0:00:00	
12-Feb-2000	9:48:34	Test913_800_006	REG_H11P28_T14P9_DRV	Wind @3.62 volts	5	0:01:05	
12-Feb-2000	9:58:22	Test913_800_007	REG_H11P28_T14P9_DRV	Wind @3.62 volts	5	0:02:23	
12-Feb-2000	10:24:14	Test913_800_008	REG_H11P28_T14P9_DRV	Wind @3.62 volts	5	0:03:06	
12-Feb-2000	10:34:25	Test913_800_009	REG_H11P28_T14P9_DRV	Wind @3.62 volts	5	0:04:01	
12-Feb-2000	10:44:34	Test913_800_010	REG_H11P28_T14P9_DRV	Wind @3.62 volts	5	0:04:50	
12-Feb-2000	10:54:39	Test913_800_011	REG_H11P28_T14P9_DRV	Wind @3.62 volts	5	0:05:35	
12-Feb-2000	11:04:35	Test913_800_012	REG_H11P28_T14P9_DRV	Wind @3.62 volts	5	0:06:28	
12-Feb-2000	11:14:07	Test913_800_013	REG_H11P28_T14P9_DRV	Wind @3.62 volts	5	0:07:19	
12-Feb-2000	11:26:27	Test913_800_014	REG_H11P28_T14P9_DRV	Wind @3.62 volts	5	0:08:23	
12-Feb-2000	11:35:51	Test913_800_015	REG_H11P28_T14P9_DRV	Wind @3.62 volts	5	0:09:19	
12-Feb-2000	11:45:51	Test913_800_016	REG_H11P28_T14P9_DRV	Wind @3.62 volts	5	0:10:17	
12-Feb-2000	11:55:18	Test913_800_017	REG_H11P28_T14P9_DRV	Wind @3.62 volts	5	0:11:08	
12-Feb-2000	13:38:15	Test913_800_018	REG_H11P28_T14P9_DRV	Wind @3.62 volts	5	0:12:05	
12-Feb-2000	13:51:17	Test913_800_019	REG_H11P28_T14P9_DRV	Wind @3.62 volts	5	0:13:09	
12-Feb-2000	14:01:07	Test913_800_020	REG_H11P28_T14P9_DRV	Wind @3.62 volts	5	0:14:23	
12-Feb-2000	14:11:35	Test913_800_021	REG_H11P28_T14P9_DRV	Wind @3.62 volts	5	0:15:28	

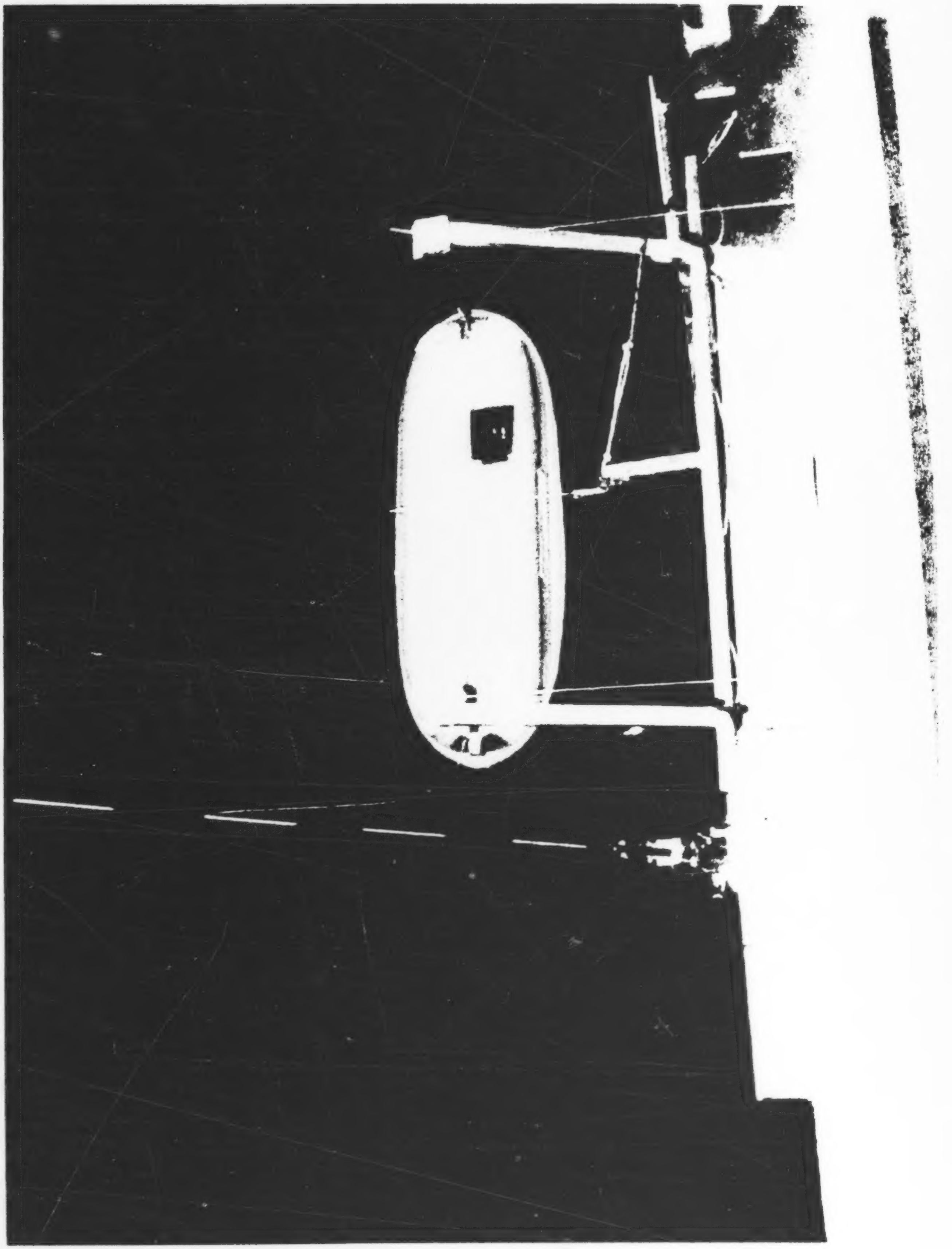
Lifeboat Launch FPSO at 20 deg heading,enhanced deployment, Ballast cond. Calm water

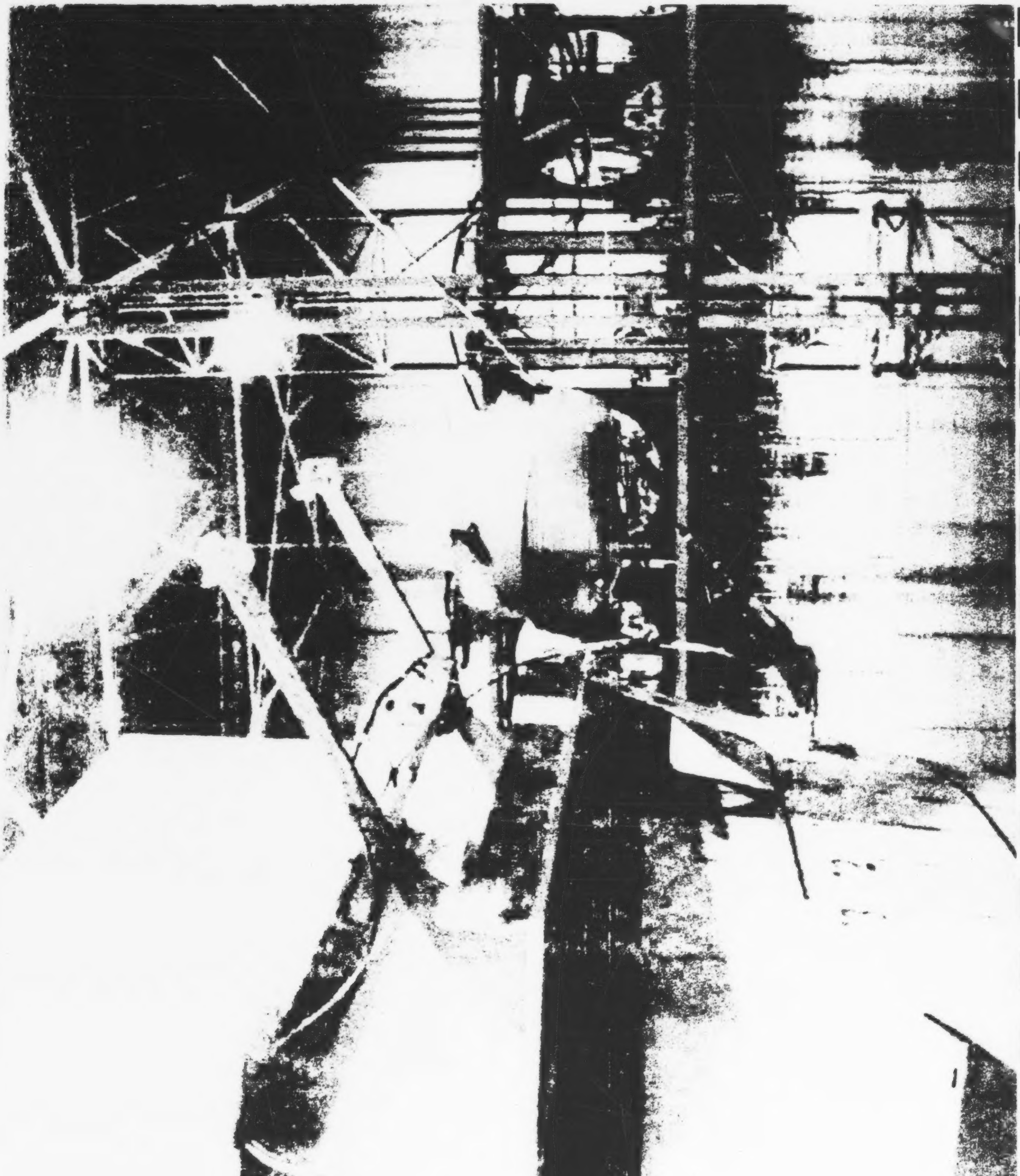
12-Feb-2000	14:21:47	Test913_700_001	n/a	n/a	5	0:16:40	
12-Feb-2000	14:25:11	Test913_700_002	n/a	n/a	5	0:17:18	
12-Feb-2000	14:27:53	Test913_700_003	n/a	n/a	5	0:17:51	
12-Feb-2000	14:30:59	Test913_700_004	n/a	n/a	5	0:18:35	
12-Feb-2000	14:34:03	Test913_700_005	n/a	n/a	5	0:19:11	Lifeboat release fail
12-Feb-2000	14:37:01	Test913_700_006	n/a	n/a	5	0:19:47	
12-Feb-2000	14:39:29	Test913_700_007	n/a	n/a	5	0:20:26	
12-Feb-2000	14:42:01	Test913_700_008	n/a	n/a	5	0:20:56	
12-Feb-2000	14:45:01	Test913_700_009	n/a	n/a	5	0:21:30	
12-Feb-2000	14:47:41	Test913_700_010	n/a	n/a	5	0:22:05	
12-Feb-2000	14:50:25	Test913_700_011	n/a	n/a	5	0:23:04	
12-Feb-2000	15:29:22	Test913_700_012	n/a	n/a	5	0:23:34	
12-Feb-2000	15:31:56	Test913_700_013	n/a	n/a	5	0:24:06	
12-Feb-2000	15:34:19	Test913_700_014	n/a	n/a	5	0:24:43	
12-Feb-2000	15:37:03	Test913_700_015	n/a	n/a	5	0:25:25	
12-Feb-2000	15:39:10	Test913_700_016	n/a	n/a	5	0:26:00	
12-Feb-2000	15:41:19	Test913_700_017	n/a	n/a	5	0:26:30	
12-Feb-2000	15:43:33	Test913_700_018	n/a	n/a	5	0:27:01	
12-Feb-2000	15:45:36	Test913_700_019	n/a	n/a	5	0:27:30	
12-Feb-2000	15:47:39	Test913_700_020	n/a	n/a	5	0:28:00	
12-Feb-2000	15:49:59	Test913_700_021	n/a	n/a	5	0:28:29	

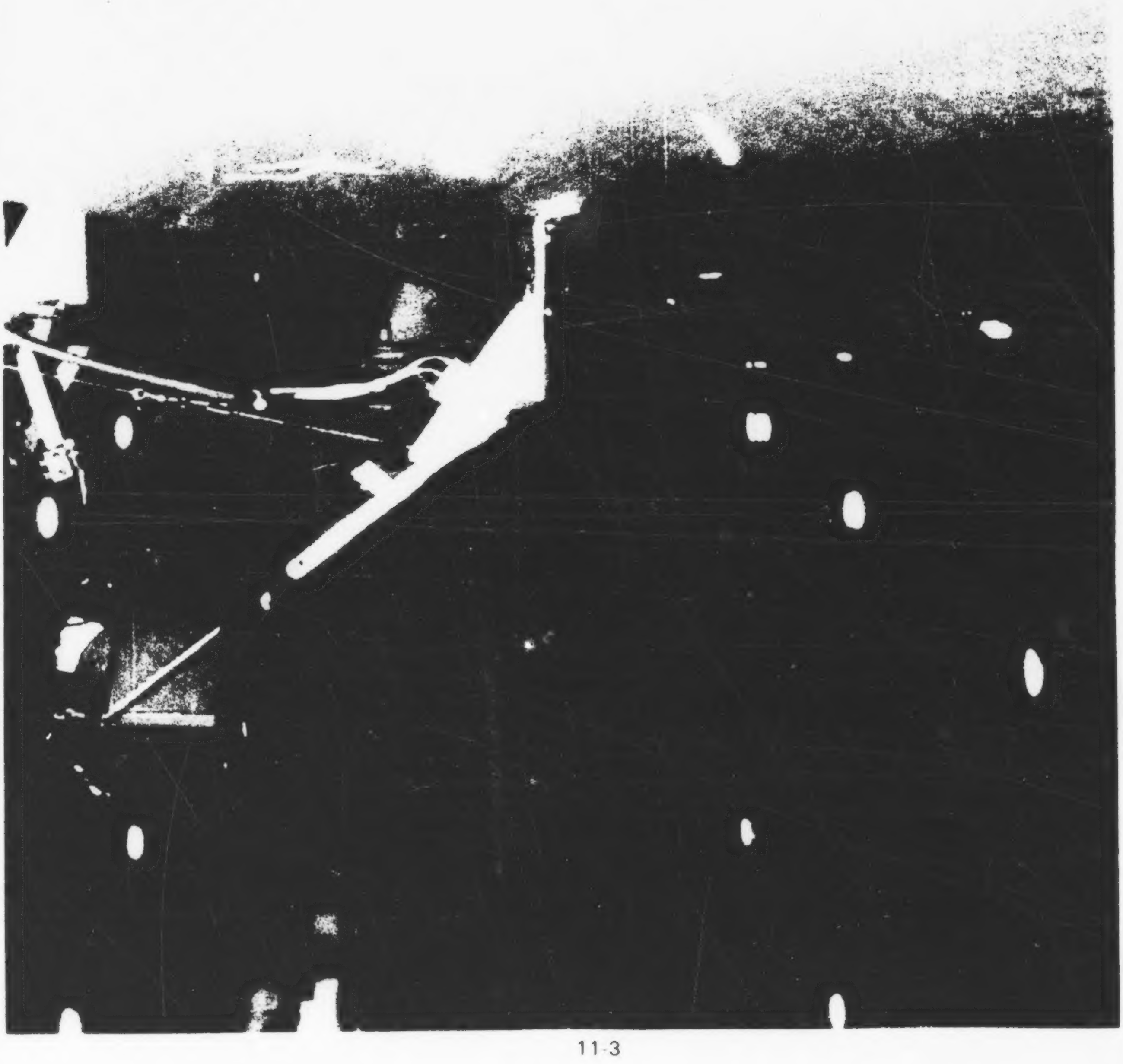
Evacuation System PJ913 Research Program

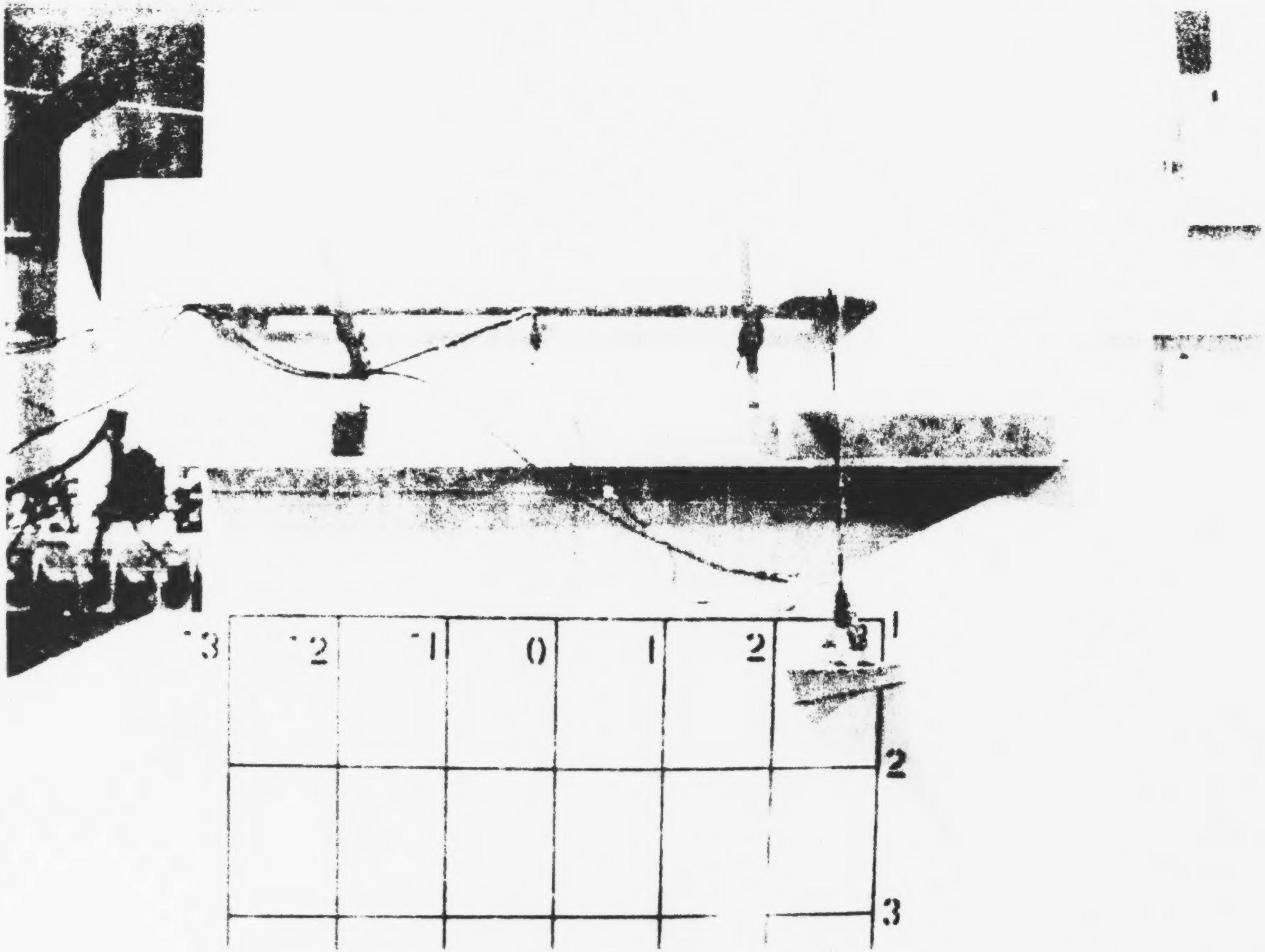
	Lifeboat Launch FPSO at 20 deg heading,enhanced deployment, Ballast cond. 7.5m Irr wave cond.						
12-Feb-2000	16:00:29	Test913_900_008	JON_HS7P5_TP13P0_DRV_M	Wind @ 4.22volts	5	0:28.59	
12-Feb-2000	16:10:15	Test913_900_009	JON_HS7P5_TP13P0_DRV_M	Wind @ 4.22volts	5	0:30.06	Video incorrectly labeled _010
	Lifeboat Launch FPSO at 20 deg heading,enhanced deployment, Ballast cond. 7.m Irr wave cond.						
12-Feb-2000	16:20:10	Test913_900_010	JON_HS10P9_TP14P8_DRV_M	Wind @ 5.3 volts	5	0:31:54	
12-Feb-2000	16:30:00	Test913_900_011	JON_HS10P9_TP14P8_DRV_M	Wind @ 5.3 volts	5	0:33:29	
							FPSO re-ballasted to heavy displacement to complete decays
15-Feb-2000			**Post test decays, moored fpso, heavy disp.**				
15-Feb-2000	15:39:59	Test913_216_001	Surge decay	n/a			
15-Feb-2000	16:20:47	Test913_213_001	Roll decay	n/a			
15-Feb-2000	16:33:24	Test913_214_001	Pitch decay	n/a			
15-Feb-2000	16:38:34	Test913_214_002	Pitch decay	n/a			
15-Feb-2000	16:58:00	Test913_215_001	Heave decay	n/a			
16-Feb-2000	9:34:27	Test913_216_002	Heave decay	n/a			
			Post test decays, Unmoored fpso, heavy disp.				
16-Feb-2000	11:16:43	Test913_212_001	Heave decay	n/a			
16-Feb-2000	11:32:01	Test913_210_001	Roll decay	n/a			
16-Feb-2000	11:40:26	Test913_211_001	Pitch decay	n/a			Daqbook failure during run, file saved with neff info only.

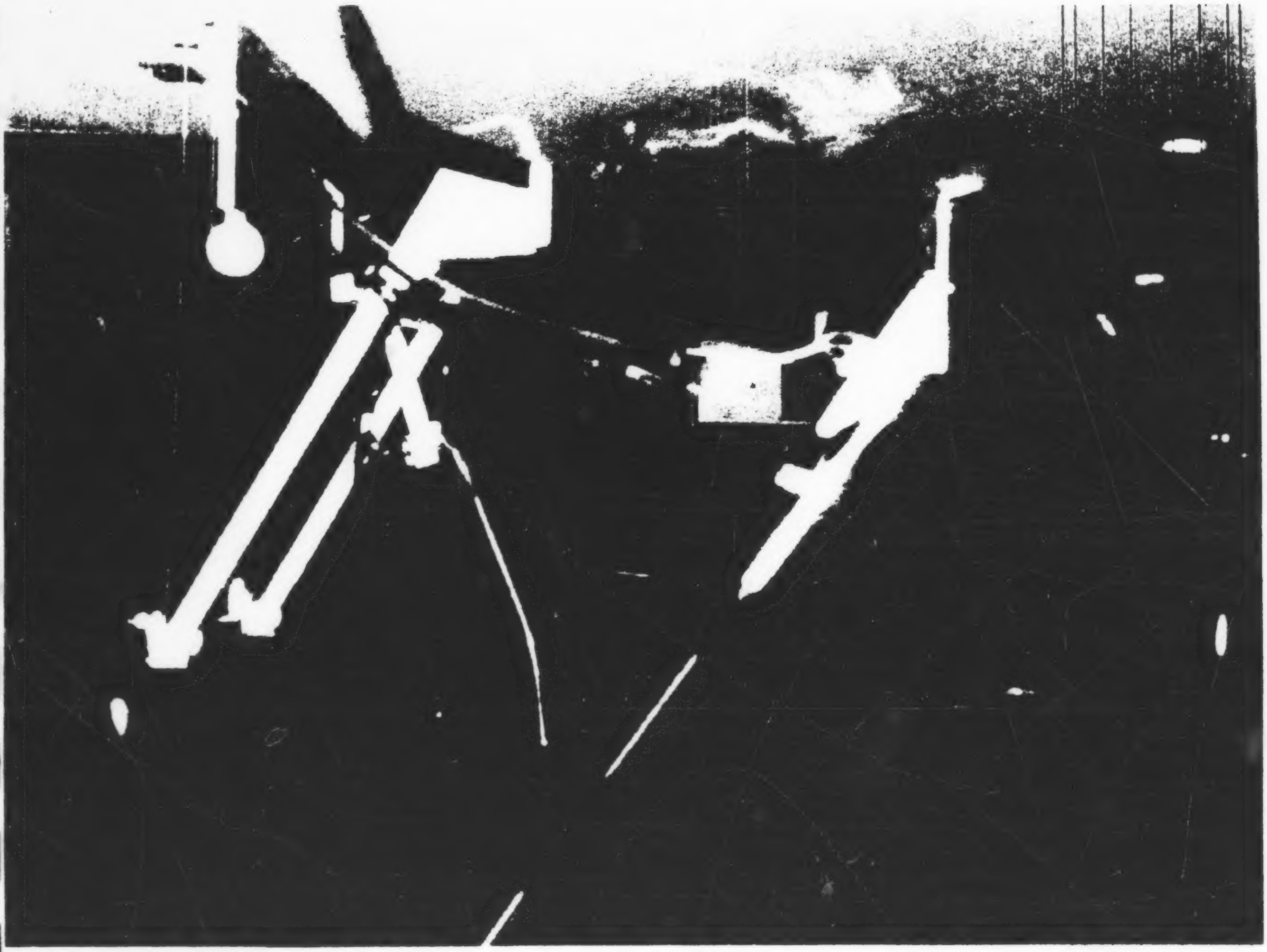
Appendix 11 Selected Photographs of Construction, Setup and Testing Phases

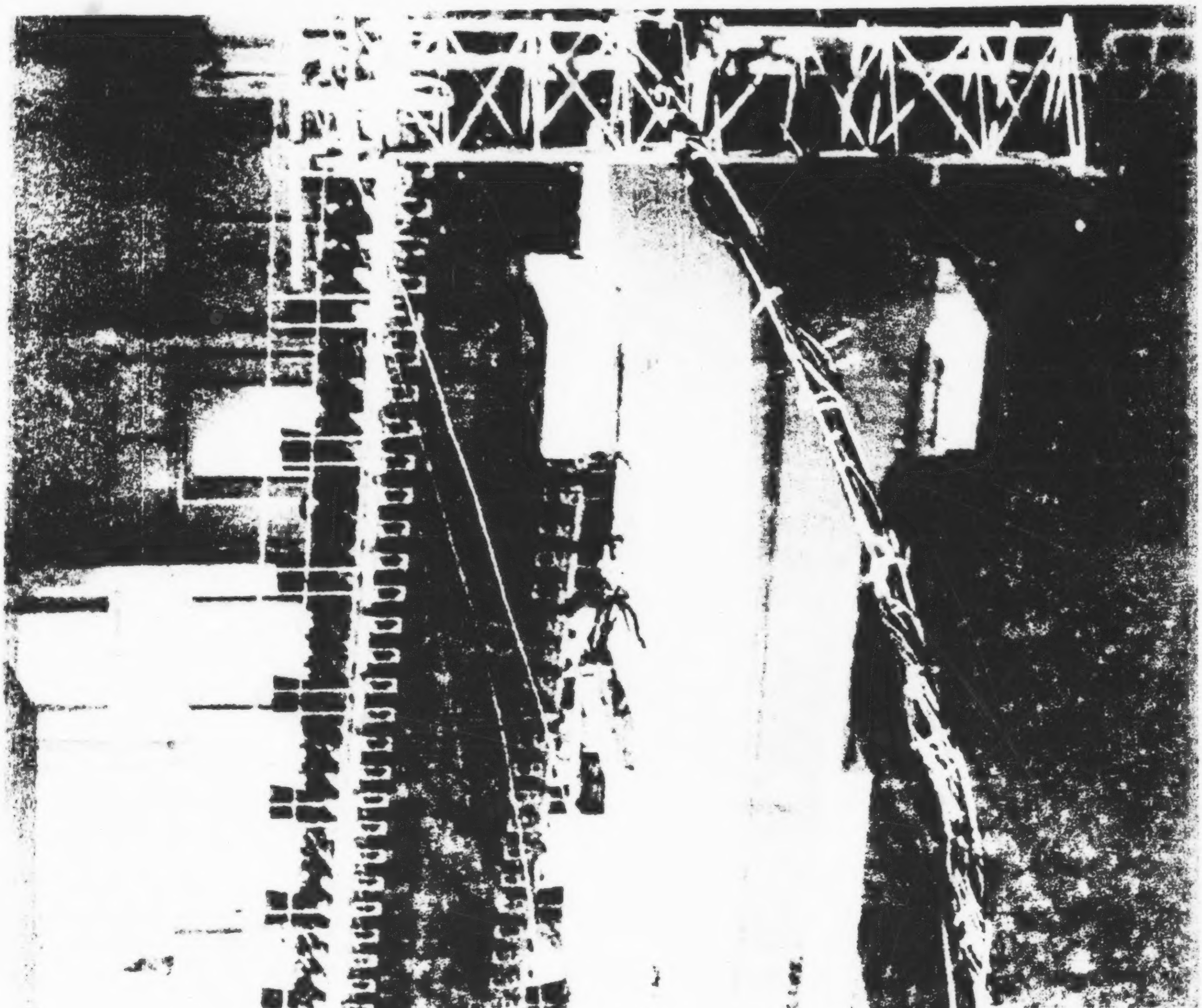


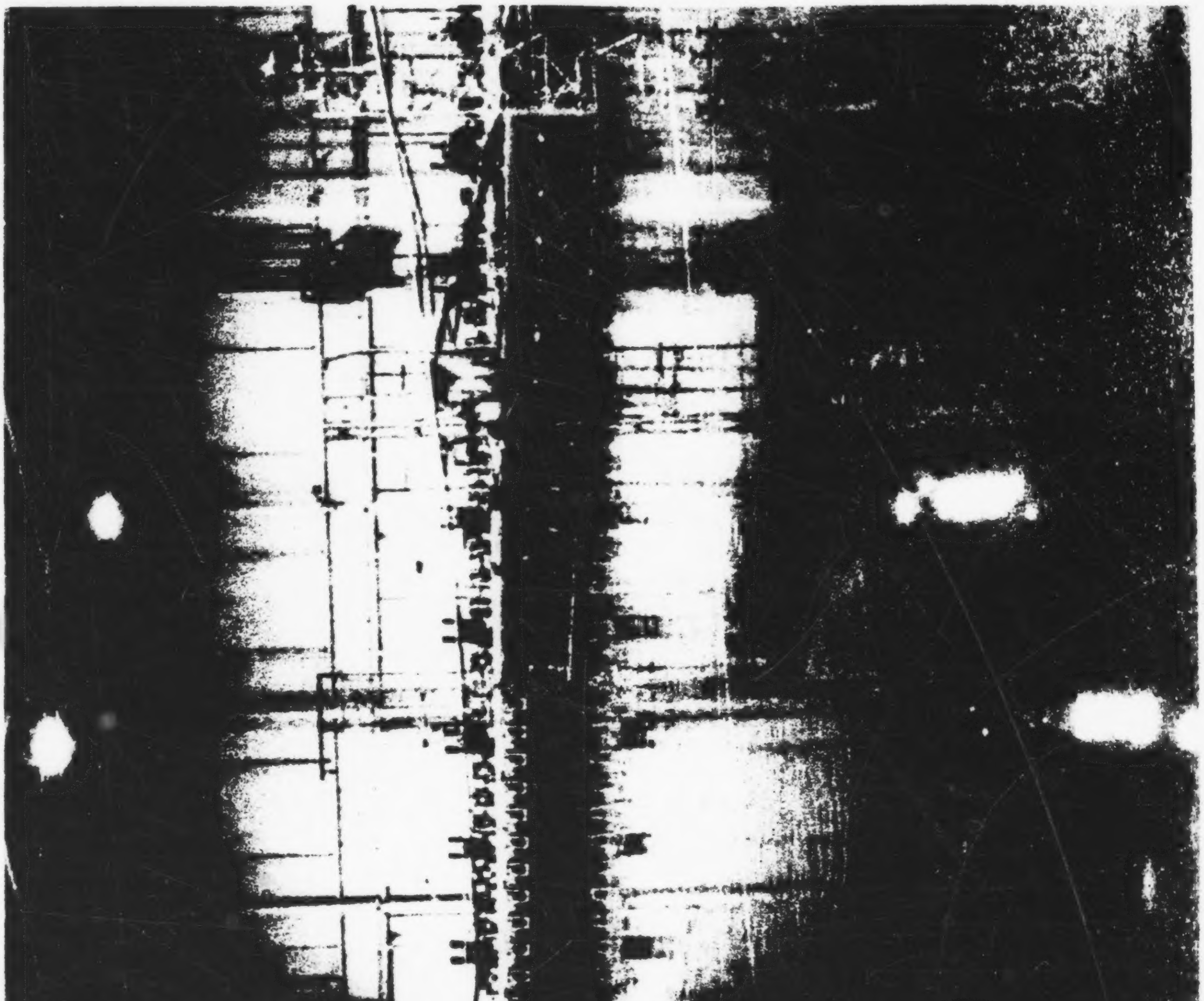


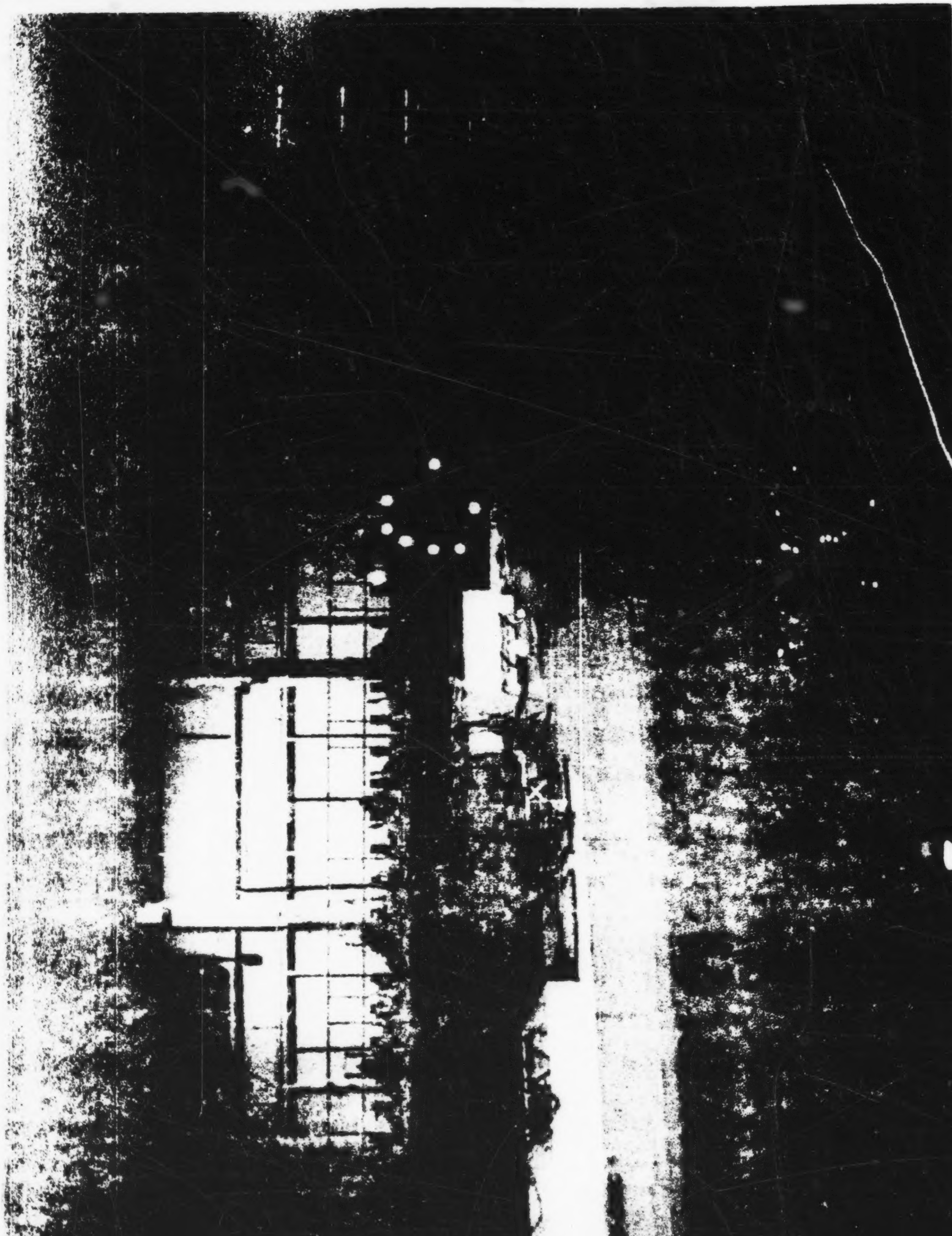



-3
-2
-1
0
1
2
1
2
3

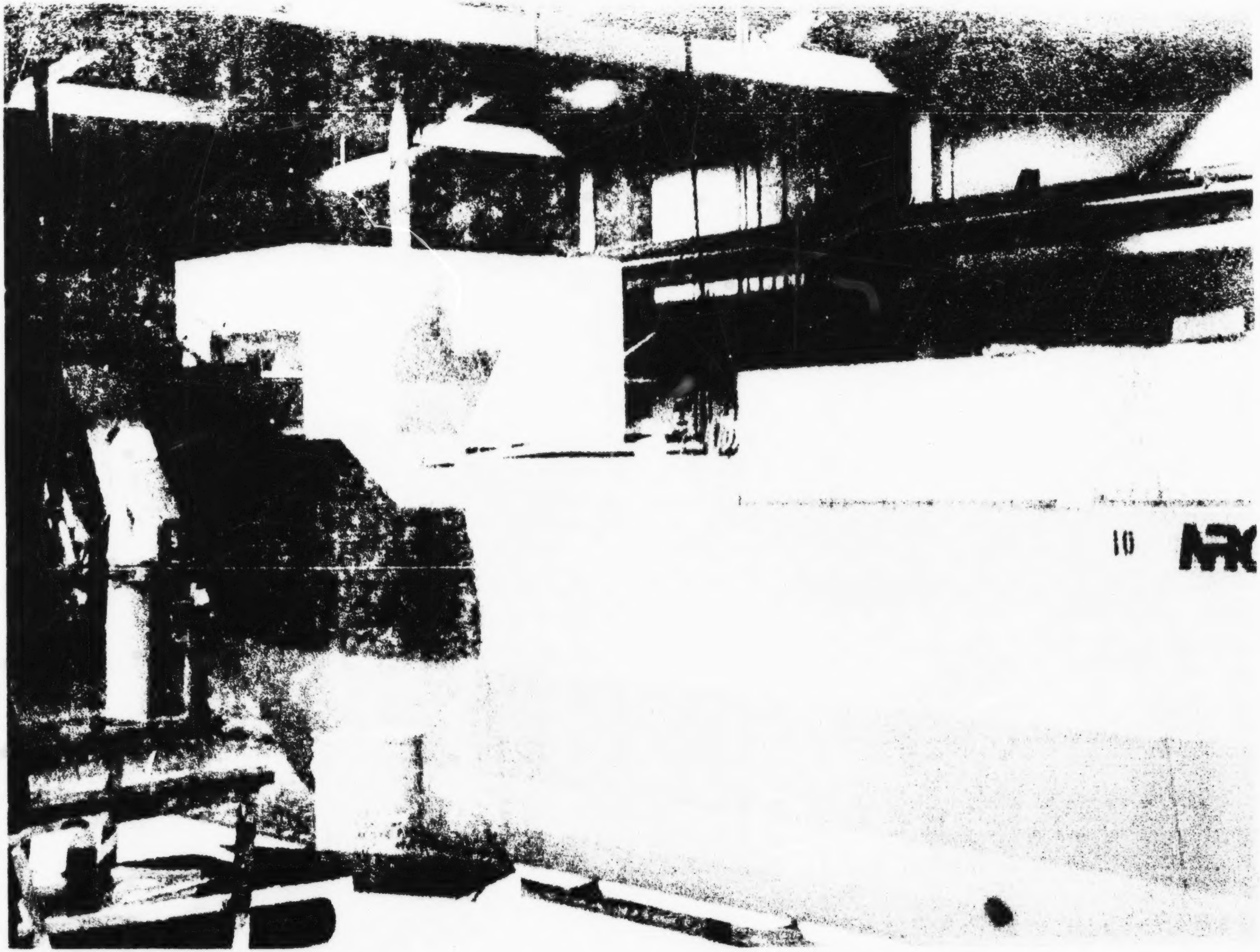


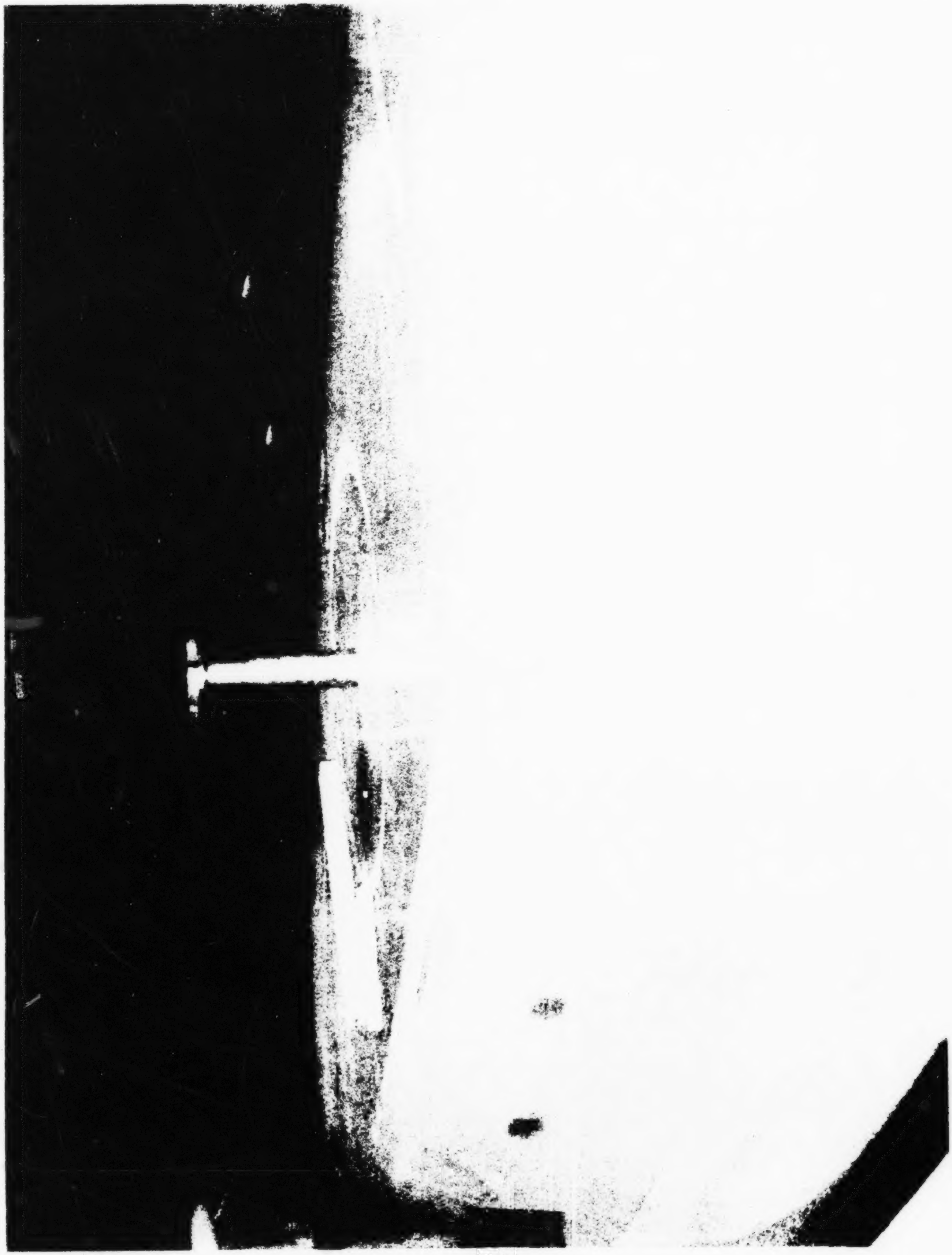




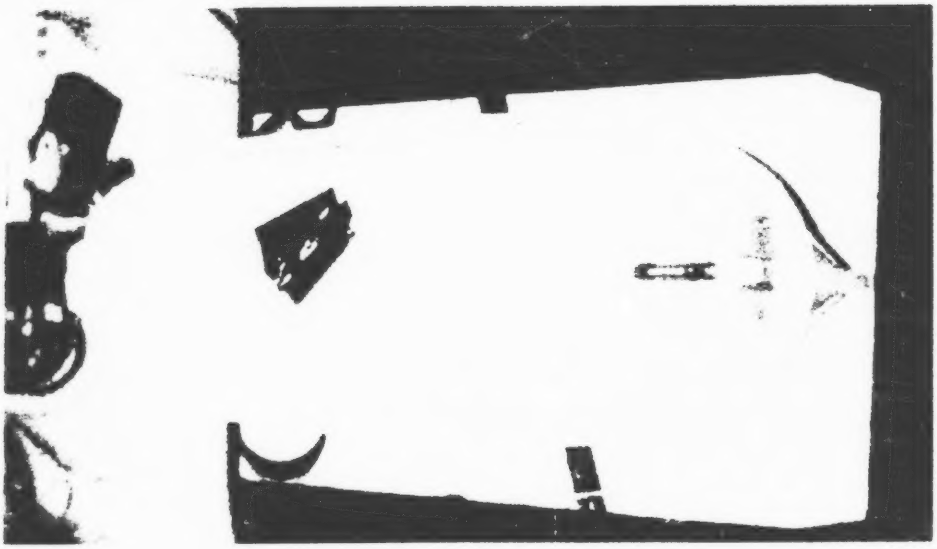


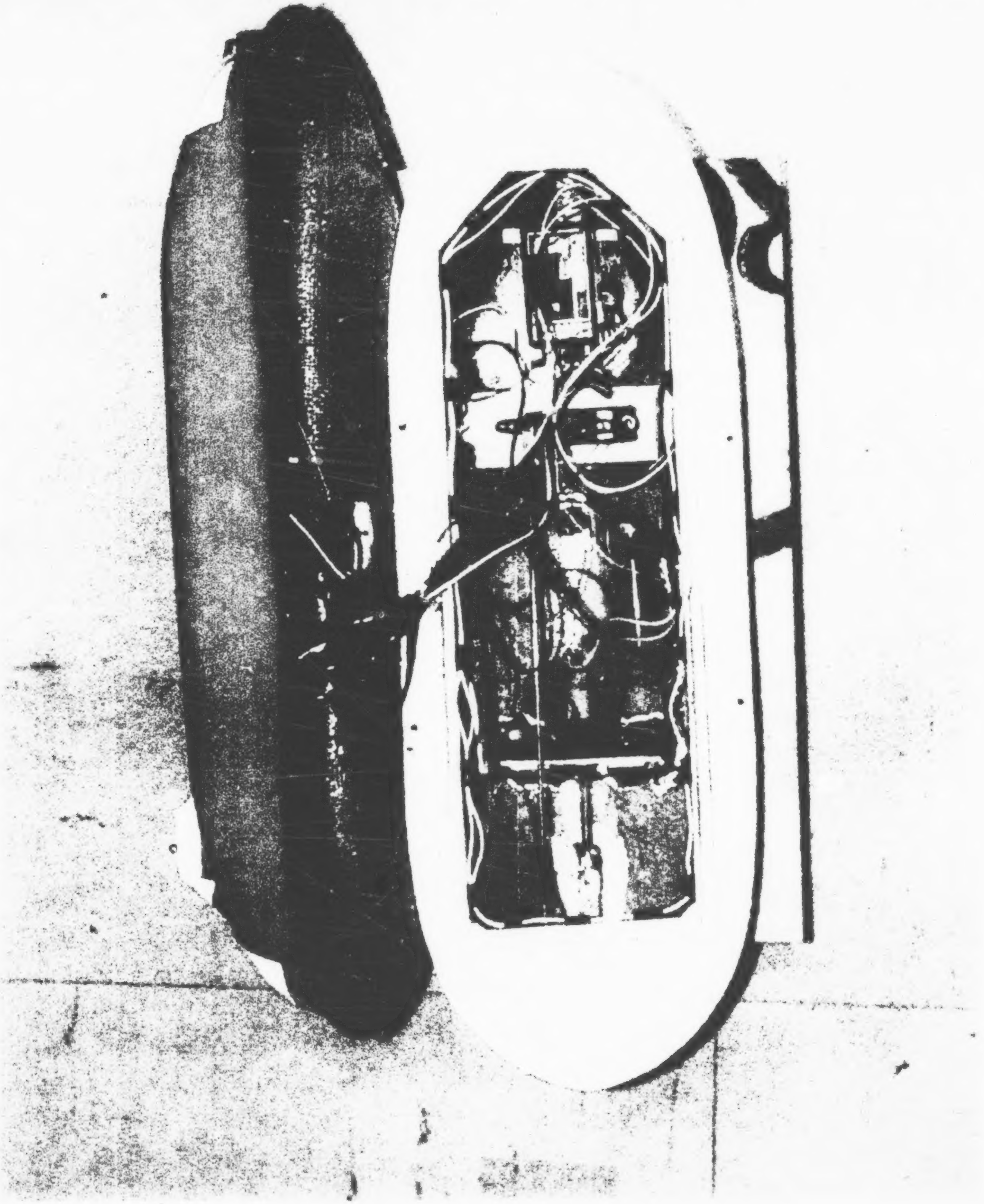
11-8

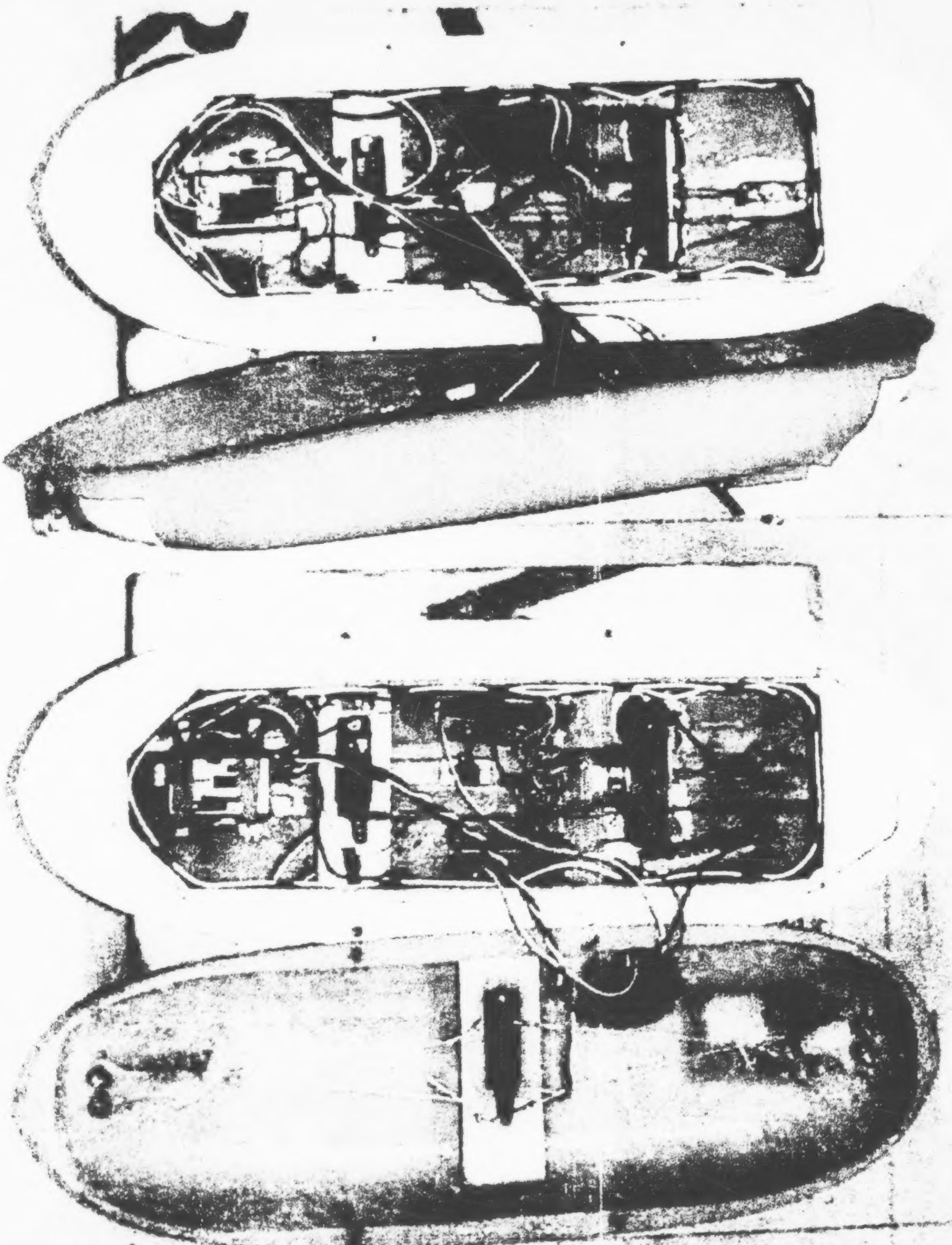

10
NRC



11 11







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